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WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

LOW FLOW MANAGEMENT FRAMEWORK PLAN

SUSQUEHANNA RIVER BASIN COMMISSION
DEC. 24, 1970
N.Y.
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SRBC
SUSQUEHANNA RIVER BASIN COMMISSION

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The Susquehanna River Basin Commission was created as an independent agency by a Federal-Interstate Compact* among the States of Maryland, New York, Commonwealth of Pennsylvania and the Federal Government. In creating the Commission, the Congress and State Legislatures formally recognized the water resources of the Susquehanna River basin as a regional asset vested with local, State and National interests for which all the parties share responsibility. As the single Federal-Interstate water resources agency with basinwide authority, the Commission's goal is to effect coordinated planning, conservation, management, utilization, development and control of basin water resources among the government and private sectors.

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* Statutory Citations: Federal - Pub. L. 91-575, 84 Stat. 1509 (December, 1970); Maryland - Natural Resources §8-301 (Michie 1974); New York - ECL §21-1301 (McKinney 1973); and Pennsylvania - 32 P.S. 820.1 (Supp. 1976).

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WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

LOW FLOW MANAGEMENT FRAMEWORK PLAN

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TABLE OF CONTENTS

Title | Page

I. INTRODUCTION..... 1

II. PHYSICAL CHARACTERISTICS OF THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN..... 5

A. Area, Climate, Precipitation, and Runoff..... 5
B. General Description of the Subbasin's Water Resources..... 6

1. Surface Water Bodies..... 6
2. Stream Flows..... 11
3. Ground Water..... 17
4. Surface Water/Ground-Water Interaction..... 21
5. Water Quality..... 22
6. Recreation..... 23

C. Population..... 24
D. Land Use..... 26
E. Business and Industry..... 26
F. Subbasin Sections..... 28

III. METHODOLOGY FOR WATER USE CALCULATIONS..... 32

A. General..... 32
B. Municipal Water Use..... 32
C. Self-Supplied Industrial Water Use..... 34
D. Self-Supplied Domestic Water Use..... 36
E. Diversions..... 36
F. Agricultural Water Use..... 37

1. Livestock Water Use..... 38
2. Irrigation..... 39

G. Computation of Storage Required to Maintain the Q7-10 Value..... 40

IV. SUBBASIN SECTION 1. SINNEMAHONING CREEK..... 42

A. Water Use..... 42

1. Municipal Water Use..... 42
2. Self-Supplied Non-Mineral Industrial Water Use.... 42
3. Self-Supplied Mineral Industrial Water Use..... 42
4. Agricultural Water Use..... 47
5. Summary of Water Use in Subbasin Section 1..... 47

Title Page

B. Occurrence of Q7-10 Value..... 47

V. SUBBASIN SECTION 2. WEST BRANCH SUSQUEHANNA RIVER ABOVE CLEARFIELD CREEK..... 52

A. Water Use..... 52

1. Municipal Water Use..... 52
2. Self-Supplied Non-Mineral Industrial Water Use.... 52
3. Self-Supplied Mineral Industrial Water Use..... 52
4. Agricultural Water Use..... 57
5. Summary of Water Use in Subbasin Section 2..... 57

B. Occurrence of Q7-10 Value..... 57

VI. SUBBASIN SECTION 3. CLEARFIELD CREEK AND WEST BRANCH SUSQUEHANNA RIVER FROM CLEARFIELD CREEK TO MOSHANNON CREEK..... 64

A. Water Use..... 64

1. Municipal Water Use..... 64
2. Self-Supplied Non-Mineral Industrial Water Use.... 64
3. Self-Supplied Mineral Industrial Water Use..... 68
4. Agricultural Water Use..... 68
5. Summary of Water Use in Subbasin Section 3..... 68

B. Occurrence of Q7-10 Value..... 68

VII. SUBBASIN SECTION 4. MOSHANNON CREEK AND WEST BRANCH SUSQUEHANNA RIVER FROM MOSHANNON CREEK TO SINNEMAHONING CREEK..... 75

A. Water Use..... 75

1. Municipal Water Use..... 75
2. Self-Supplied Non-Mineral Industrial Water Use.... 75
3. Self-Supplied Mineral Industrial Water Use..... 75
4. Agricultural Water Use..... 80
5. Summary of Water Use in Subbasin Section 4..... 80

B. Occurrence of Q7-10 Value..... 80

Title Page

VIII. SUBBASIN SECTION 5. BALD EAGLE CREEK..... 82

A. Water Use..... 82

1. Municipal Water Use..... 82
2. Self-Supplied Non-Mineral Industrial Water Use... 82
3. Self-Supplied Mineral Industrial Water Use..... 82
4. Agricultural Water Use..... 90
5. Summary of Water Use in Subbasin Section 5..... 90

B. Occurrence of Q7-10 Value..... 90

IX. SUBBASIN SECTION 6. WEST BRANCH SUSQUEHANNA RIVER FROM MOUTH OF SINNEMAHONING CREEK TO AND INCLUDING PINE CREEK..... 95

A. Water Use..... 95

1. Municipal Water Use..... 95
2. Self-Supplied Non-Mineral Industrial Water Use.... 95
3. Self-Supplied Mineral Industrial Water Use..... 95
4. Agricultural Water Use.....100
5. Summary of Water Use in Subbasin Section 6.....100

B. Occurrence of Q7-10 Value.....100

X. SUBBASIN SECTION 7. WEST BRANCH SUSQUEHANNA RIVER FROM MOUTH OF PINE CREEK TO AND INCLUDING LYCOMING CREEK.....102

A. Water Use.....102

1. Municipal Water Use.....102
2. Self-Supplied Non-Mineral Industrial Water Use....102
3. Self-Supplied Mineral Industrial Water Use.....102
4. Agricultural Water Use.....102
5. Summary of Water Use in Subbasin Section 7.....106

B. Occurrence of Q7-10 Value.....106

XI. SUBBASIN SECTION 8. LOYALSOCK CREEK.....111

A. Water Use.....111

1. Municipal Water Use.....111
2. Self-Supplied Non-Mineral Industrial Water Use....111
3. Self-Supplied Mineral Industrial Water Use.....111

Title | Page

4. Agricultural Water Use.....115
5. Summary of Water Use in Subbasin Section 8.....115

B. Occurrence of Q7-10 Value.....115

XII. SUBBASIN SECTION 9. WEST BRANCH SUSQUEHANNA RIVER BELOW LYCOMING CREEK EXCEPT LOYALSOCK CREEK.....120

A. Water Use.....120

1. Municipal Water Use.....120
2. Self-Supplied Non-Mineral Industrial Water Use....120
3. Self-Supplied Mineral Industrial Water Use.....120
4. Agricultural Water Use.....128
5. Summary of Water Use in Subbasin Section 9.....128

B. Occurrence of Q7-10 Value.....128

XIII. PRESENT AND FUTURE LOW FLOW PROBLEMS AND NEEDS.....134

A. General.....134
B. Aggregated Consumptive Use and Maintenance of the Q7-10 Value.....136
C. Other Considerations.....139

1. Acid Mine Drainage and Low Flows.....139
2. Data Needs.....141
- General.....141
- Desired Flows to the Chesapeake Bay.....142

XIV. ALTERNATIVE MANAGEMENT ACTIONS.....143

A. General.....143
B. Water Conservation.....143
C. Surface Water Reservoirs.....144

1. Potential Releases From Existing Reservoirs.....144
2. New Reservoir Sites.....146

XV. CONCLUSIONS.....149

XVI. REFERENCES.....151

Title | Page

APPENDICES

A -- Supporting Data for Industrial Water Use Calculations....A-1
B -- Potential Reservoir Sites in the West Branch
Susquehanna River Subbasin.....B-1
C -- Agricultural Water Use Data.....C-1
D -- Social-Political Considerations.....D-1

I. INTRODUCTION

This report is the third in a series of low flow management framework plans prepared by the Susquehanna River Basin Commission (SRBC). The objectives of these reports are to identify existing and potential water supply problems, provide guidance for programs of the SRBC and other resource agencies, and provide the foundation for future water supply planning. Framework planning reports were previously prepared for the Chemung and Eastern New York Subbasins. Planning efforts are currently underway for the Juniata Subbasin (Figure 1). Ultimately, framework plans will be developed for all six subbasins and will be integrated to facilitate management of the available water resource during periods of low flows in the Susquehanna River Basin.

The Susquehanna River Basin Commission's (SRBC's) Comprehensive Plan states that the objective of the water supply program is "Fulfillment of immediate and projected long-range demands of the people of the basin for domestic, municipal, agricultural, and industrial water supply, including use for cooling and irrigation." Several relevant goals of the water supply program are listed as follows:

1. Coordination of water supply, water quality, and land use planning development programs.

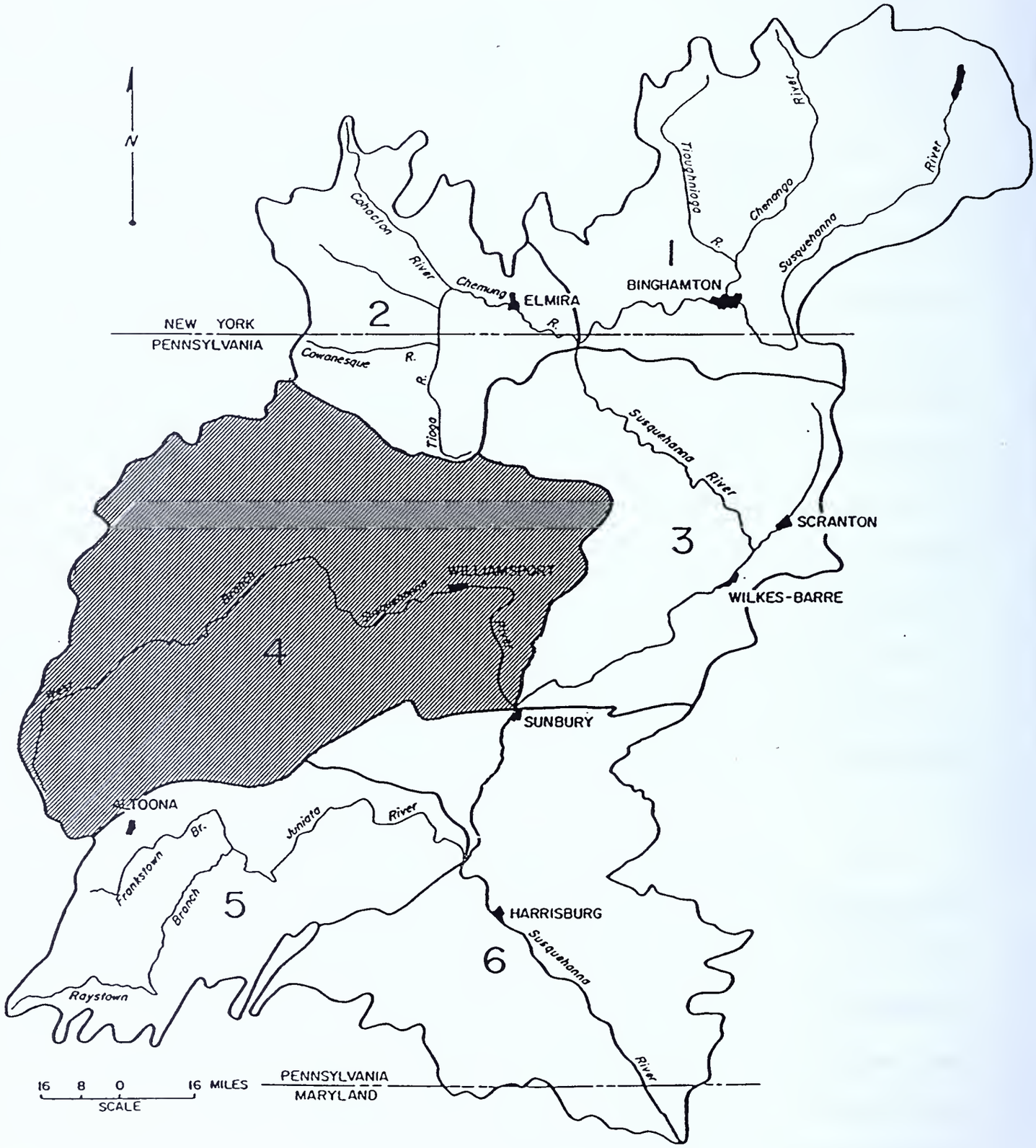


FIGURE 1

THE SUSQUEHANNA RIVER BASIN COMMISSION

UNITED STATES-NEW YORK-PENNSYLVANIA-MARYLAND

HYDROLOGIC SUBBASINS

LEGEND

Subbasin 1 – Eastern New York
Subbasin 2 – Chemung
Subbasin 3 – Upper Susquehanna
Subbasin 4 – West Branch Susquehanna
Subbasin 5 – Juniata
Subbasin 6 – Lower Susquehanna

2. Development of basinwide and regional plans for the conservation, development, management, and use of the surface and ground waters of the basin for domestic, municipal, industrial, and agricultural use.

3. Establishment of an equitable system for the allocation of water for various uses, including protection of instream flows, and protection of the receiving waters of the Chesapeake Bay.

4. Development of contingency management plans for immediate implementation during water-short periods.

5. Prevention of reduction of low flows into the Chesapeake Bay, including development of policies for reducing future consumptive losses.

The SRBC low flow management framework plans will facilitate development of an equitable system for water management during water-short periods. Surface and ground-water availability are examined with particular emphasis on low flow frequency and duration. Water use and historic low flows are analyzed to identify existing and future water supply problems within specific geographic areas. Potential management actions are identified for further consideration. Data gaps are identified and discussed. The plans are intended to be dynamic and may be modified as water supply needs change.

The SRBC framework plans use the 7-day 10-year low flow (Q7-10) value as an indicator to identify historical low flow periods, and to determine potential water supply deficits during a repeat of the most severe historical low flow period. The Q7-10 value is used as a planning tool for comparison purposes. No claim is made that maintenance of the Q7-10 value fulfills instream flow requirements within the subbasin, or that the Q7-10 value must be maintained.

II. PHYSICAL CHARACTERISTICS OF THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

A. AREA, CLIMATE, PRECIPITATION, AND RUNOFF

The West Branch Susquehanna River Subbasin covers an area of about 7,000 square miles in central Pennsylvania. It is about one-fourth of the area of the Susquehanna River Basin, which covers about 27,500 square miles in Pennsylvania, New York and Maryland.

The West Branch Susquehanna River Subbasin has a climate that is influenced primarily by continental weather systems originating to the west of Pennsylvania (Pa. DER, 1979a, 1979b, and 1980). Major systems moving eastward generally subject the area to relatively rapid changes in the weather. Occasionally, air moving northward from the Gulf of Mexico brings moderate to heavy precipitation to the area and serves as a modifying climatic factor.

Air temperatures vary widely throughout the subbasin due to the effects of mountainous topography. The area also experiences somewhat lower temperatures and more rapid temperature changes than other areas in Pennsylvania. The mean annual freeze-free period ranges from about 130 days in some northern areas of the subbasin to about 165 days in the south. In the south-central portion of the subbasin, at Lock Haven, temperatures have been recorded as high as 106°F. and as low as -22°F. The daily temperature range is about 17°F. in mid-winter and 26°F. in mid-summer.

The mean annual precipitation is about 40 inches (Taylor and others, 1983). Precipitation is relatively evenly distributed throughout the year, although much precipitation falling during the winter months occurs as snow.

Early spring is generally the time of greatest runoff, when water from melting snow often combines with spring rains. Taylor and others (1983) state that total runoff averages about 55 to 60 percent of annual precipitation (23.2 to 23.4 inches), except in the area draining into Spring Creek, where it is about 38 percent (14.2 inches). They suggest that the decreased percentage of runoff from the Spring Creek drainage area may in part be due to higher average summer temperatures (about 3-4°F.), which result in higher evapotranspiration rates.

B. GENERAL DESCRIPTION OF THE SUBBASIN'S WATER RESOURCES

1. Surface Water Bodies

The West Branch Susquehanna River originates in the Appalachian Plateaus Physiographic Province near Elnora in Cambria County, Pa. (Figure 2). The West Branch flows generally to the north through low, rolling hills and then turns northeastward, passing through steep, forested hillsides and proceeding towards Renovo in Clinton County. Downstream of Renovo, the river bends sharply towards the southeast, cuts through the steep Allegheny Front at Lock Haven, and enters the Ridge and Valley Province, which is characterized by broad valleys separated by long, high ridges. From Lock Haven,

Note: Station mbers are abbreviated. First two digit and last two digits (if zeros) are omitted. (Ex.- Station number 01542500 s shown as 5425.)

FIGURE 2

TRIBUTARIES AND STREAM GAGING STATIONS IN THE WEST BRANCH SUSQQEHANNA RIVER SUBBASIN

▲ Existing Station (1984)
Discontinued Station

Source: U.S. Geological Survey, 1970-1984

the river flows generally northeast past Williamsport and curves to the south, flowing past Lewisburg to join the main stem of the Susquehanna River at Northumberland, Pa.

Major tributaries of the West Branch, with their respective drainage areas given in square miles, include Chest Creek (129), Clearfield Creek (393), Moshannon Creek (274), Sinnemahoning Creek (1035), Kettle Creek (246), Bald Eagle Creek (770), Pine Creek (979), Lycoming Creek (272), Loyalsock Creek (494), and Muncy Creek (215).

Natural lakes in the area are small and relatively few in number. However, six large flood control impoundments are located in the subbasin. Curwensville, Alvin R. Bush, and Foster Joseph Sayers Dams are owned and operated by the U.S. Army Corps of Engineeers. George B. Stevenson Dam was constructed by the Commonwealth of Pennsylvania, but is operated by the Corps of Engineers during flood events. Glendale and Little Pine Creek Reservoirs are owned and operated by the Pennsylvania Department of Environmental Resources (Pa. DER). In addition to providing flood protection, all six reservoirs have associated recreational facilities. Foster Joseph Sayers Dam is also operated to minimize the effects of acid mine pollution. Reservoir pool areas and volumes are included in Table 1.

TABLE 1

POOL AREAS & VOLUMES FOR MAJOR FLOOD CONTROL PROJECTS
IN THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

	Curwensville Dam & Lake	A. R. Bush Dam & Kettle Creek Lake	Foster J. Sayers Dam & Blanchard Res.	George B. Stevenson Dam & First Fork Sinnemahoning Creek Reservoir	Little Pine Creek Lake	Glendale Lake
Summer Pool Area (Acres)	790	166	1,730[1]	142	93.7	1,600
Summer Pool Capacity (Acre-Feet)	9,540	1,740	28,800	2,000	1,100	25,300
Winter Pool Area (Acres)	540	166	630	142	93.7	1,600
Winter Pool Capacity (Acre-Feet)	4,900	1,740	6,300	2,000	1,100	25,300
Flood Pool Area (Acres)[2]	3,020	1,430	3,450	1,470	634	2,140
Flood Pool Capacity[2] (Acre-Feet)	124,200	75,000	99,000	75,800	24,800	41,200

Source: U.S. Army Corps of Engineers (1984a, 1984b, 1986a and 1987), Pa. DER (1978) and personal communication with Pa. DER staff (1987).

[1] May vary somewhat due to fishery and water quality management actions.

[2] To top of spillway.

Curwensville Dam and Lake are located on the West Branch Susquehanna River directly upstream of the Borough of Curwensville in Clearfield County. The dam was operational in November 1965, and the lake was filled to its winter pool elevation in December 1965. The lake was first filled to its summer pool elevation in May 1967.

The Alvin R. Bush Dam and Kettle Creek Lake are located on Kettle Creek about 8.4 miles upstream of its mouth. The dam was completed on January 18, 1962 and the lake was filled to its normal, year-round recreation pool in August 1962.

Foster Joseph Sayers Dam and Blanchard Reservoir are located on Bald Eagle Creek about 14 miles upstream of its mouth. The dam was completed in August 1969. Storage in the reservoir began in March 1971.

Generally, Blanchard Reservoir is filled to summer pool elevation between March 1 and May 15. The filling rate is determined by water quality conditions both in the reservoir and downstream. Although the normal summer pool level is at elevation 630 (producing a 1,730-acre reservoir), it may be filled to elevation 632 (1,850 acre reservoir) if requested by the Commonwealth of Pennsylvania for fishery management purposes. The summer pool level may be drawn down to as low as elevation 628 if releases are required to buffer acid discharges in the West Branch. The reservoir is drawn down to winter pool level by November each year.

George B. Stevenson Dam and First Fork Sinnemahoning Creek Reservoir are located on First Fork Sinnemahoning Creek about 8 miles above its confluence with Sinnemahoning Creek. The dam was operational in 1956. The reservoir is maintained at a year-round recreational pool level.

Little Pine Creek Lake was completed in 1960 and is located on Little Pine Creek in Little Pine Creek State Park, about four miles north of Waterville in Lycoming County, Pa. Glendale Lake was completed in 1950 and is located on Beaver Dam Run in Prince Gallitzin State Park, about four miles upstream of Coalport in Cambria County, Pa. Levels of both lakes are maintained at constant, year-round levels under normal conditions.

One existing diversion carries water out of the West Branch Susquehanna River Subbasin. The City of DuBois owns a water supply reservoir on Anderson Creek, a tributary of the West Branch Susquehanna River. Water from this reservoir is diverted out of the subbasin for use at DuBois and is then discharged within the Allegheny River Basin. Historically, the volume of water passing through this diversion has averaged about 3 million gallons per day (MGD).

2. Stream Flows

The locations of existing and recently discontinued U.S. Geological Survey (USGS) stream gaging stations in the West Branch Susquehanna River Subbasin are shown on Figure 2, page 7. Table 2 lists stations, their upstream drainage areas,

TABLE 2

STREAM GAGING STATIONS IN THE WEST BRANCH SUBBASIN

Site No.	Site Location	Upstream Drainage Area (mi^2)	Avg. Flow (ft^3/sec)	Record Low Flow (ft^3/sec)	Date	Years of Record
01541000	W. Br. Susq. R. at Bower, Pa.	315	558	14	08-29-39	Oct.'13-Present
01541200	W. Br. Susq. R. at Curwensville, Pa.	367	657	0	--	Oct.'55-Present
01541303	W. Br. Susq. R. at Hyde, Pa.	474	911	46	09-14-82	Oct.'78-Present
01541308	Bradley Run nr. Ashville, Pa.	6.77	12.0	1.2	Many days in '70, '72 &'77	Oct.'67-Feb.'80
01541500	Clearfield Crk. at Dimeling, Pa.	371	580	6.0	10-01-25 & 10-09-25	Oct.'13-Present
01542000	Moshannon Creek at Osceola Mills, Pa.	68.8	112	1.0	01-30-81	Oct.'40-Present
01542500	W. Br. Susq. R. at Karthaus, Pa.	1,462	2,511	100	09-26-64 & 09-27-64	Feb.'40-Present
01542810	Waldy Run nr. Emporium, Pa.	5.24	8.85	0	09-14-64 thru 09-19-64	Aug.'64-Pres.*
01543000	Driftwood Br. Sinnemahoning Crk. at Sterling Run, Pa.	272	451	0.4	09-07-30 & 09-12-30 thru 09-14-30	Oct.'13-Present
01543500	Sinnemahoning Crk. at Sinnemahoning, Pa.	685	1,140	1.2	09-04-39	Jul.'38-Present
01544000	First Fork Sinnemahoning Crk. nr. Sinnemahoning, Pa.	245	393	0.10	08-08-75	Oct.'53-Present

* Occasional measurements and/or partial records are available for additional years.

Site No.	Site Location	Upstream Drainage Area (mi^2)	Avg. Flow (ft^3/sec)	Record Low Flow (ft^3/sec)	Date	Years of Record
01544500	Kettle Crk. at Cross Fork, Pa.	136	227	1.2	09-02-71 thru 09-04-71	Oct.'40-Present
01545000	Kettle Crk. nr. Westport, Pa.	233	373	3.0	12-06-64	Oct.'54-Present
01545500	W. Br. Susq. R. at Renovo, Pa.	2,975	4,984	80	12-06-08	Oct.'07-Present
01545600	Young Woman's Crk. nr. Renovo, Pa.	46.2	76.1	1.1	09-06-71 & 09-07-71	Dec.'64-Present
01546500	Spring Crk. nr. Axemann, Pa.	87.2	91.9	9.6	11-24-41	Oct.'40-Present
01547100	Spring Crk. at Milesburg, Pa.	142	237	60	09-30-69	May '67-Present
01547200	Bald Eagle Crk. below Spring Crk. at Milesburg, Pa.	265	407	50	08-03-66	Oct.'55-Present
01547500	Bald Eagle Crk. at Blanchard, Pa.	339	465	0	Several times in '70, '76, & '79 due to shutoff at upstream dam	May '54-Present
01547700	Marsh Crk. at Blanchard, Pa.	44.1	59.4	0	08-30-66 & 08-31-66	Oct.'55-Present
01547770	North Fork Beech Crk. nr. Snow Shoe, Pa.	20.8	--	1.6	09-23-70	May '69-Sep.'70
01547800	South Fork Beech Crk. nr. Snow Shoe, Pa.	12.2	24.0	1.7	10-09-70 & 10-10-70	*May '69-Mar.'81
01547950	Beech Crk. at Monument, Pa.	152	285	8.8	11-17-80	Aug.'68-Present
01548000	Bald Eagle Crk. at Beech Crk. Station, Pa.	559	817	29	08-22-30	Jul.'10-Present
01548408	Wilson Crk. above Sand Run nr. Antrim, Pa.	12.6	--	0.12	08-29-81 & 08-30-81	Jul.'78-Jun.'82

* Occasional measurements and/or partial records are available for additional years.

Site No.	Site Location	Upstream Drainage Area (mi^2)	Avg. Flow (ft^3/sec)	Record Low Flow (ft^3/sec)	Date	Years of Record
01548417	Basswood Run above Hunter Drift nr. Antrim, Pa.	0.57	--	0	Many days	Jun.'78-Sep.'80
01548422	Rattler Run nr. Morris, Pa.	0.32	--	0	Several days	Jun.'78-Dec.'79
01548500	Pine Crk. at Cedar Run, Pa.	604	839	8.0	09-01-39 thru 09-03-39	Jul.'18-Present
01549500	Blockhouse Crk. nr. English Center, Pa.	37.7	58.8	0	Several days in Aug-Sep'62	Oct.'40-Present
01549700	Pine Crk. below Little Pine Crk. nr. Waterville, Pa.	944	1,432	25	09-25-64 thru 09-27-64	Oct.'57-Present
01549755	Antes Crk. nr. Jersey Shore, Pa.	53.3	--	9.6	11-11-74	Aug.'73-Sep.'77
01549780	Larrys Creek at Cogan House, Pa.	6.80	10.8	0	Many days	Apr.'60-Sep.'78
01550000	Lycoming Crk. nr. Trout Run, Pa.	173	286	3.2	09-27-36	Dec.'13-Present
01551500	W. Br. Susq. R. at Williamsport, Pa.	5,682	8,970	162	09-17-43	Mar.'95-Present
01552000	Loyalsock Crk. at Loyalsockville, Pa.	443	763	11	09-25-64 09-26-64 & 11-24-64	Aug.'25-Sep.'74 & Oct.'75-Present
01552500	Muncy Crk. nr. Sonestown, Pa.	23.8	48.8	0.1	09-11-64 thru 09-13-64	Oct.'40-Present
01553120	White Deer Crk. above Sand Spring Run nr. White Deer, Pa.	17.8	33.5	3.1	08-17-68 & 08-18-68	Jan.'68-Sep.'73
01553130	Sand Spring Run nr. White Deer, Pa.	4.93	9.28	0.83	Several days in Aug, Sep, & Oct '80	Jan.'68-Mar.'81
01553140	White Deer Crk. nr. White Deer, Pa.	40.0	76.2	0.90	08-30-68	Jan.'68-Sep.'73
01553500	W. Br. Susq. R. at Lewisburg, Pa.	6,847	10,900	390	11-16-64	Oct.'39-Present
01553600	E. Br. Chillisquaque Crk. nr. Washingtonville, Pa.	9.48	12.3	0	Many days	Apr.'60-Sep.'78

Site No.	Site Location	Upstream Drainage Area (mi^2)	Avg. Flow (ft^3/sec)	Record Low Flow (ft^3/sec)	Date	Years of Record
01553700	Chillisquaque Crk. at Washingtonville, Pa.	51.3	78.0	11	10-06-82 thru 10-08-82	May '79-Present

Note: Occasional measurements and/or partial records are available for other sites not listed. Table does not include gaged discharges from Mitchell Mine, Anna S Mine, or Hunter Drift, which are all located near Antrim, Pa.

Source: U.S. Geological Survey, 1970-1984.

average flows, and record low flows with their dates of occurrence. The period of record for stream flow data at each site is also listed.

Stream flow data for selected locations were obtained from the USGS WATSTORE data base. Statistical analyses of these data were made using the WATSTORE statistical programs.

The Q7-10 value is the lowest stream flow rate that, averaged over seven consecutive days, would have a 10 percent chance of occurring in any year. The Q7-10 value is significant because it is the criterion adopted by the SRBC for consumptive use makeup. Section 803.61 (c)(i) of the SRBC Regulations and Procedures for Review of Projects states that "compensation in an amount equal to the project's total consumptive use shall be required when the stream flow at the point of taking equals or is anticipated to equal the low flow criterion which is the 7-day 10-year low flow plus the project's total consumptive use and dedicated augmentation." The Commission also has the right to apply a higher low flow criterion for a particular stream reach when necessary for the purposes of protection of public health, stream quality control, economic development, protection of fisheries, recreation, dilution and abatement of pollution, the prevention of undue salinity, protection of Chesapeake Bay, and other purposes as determined by the Commission. Also, Section 803.61 (c)(ii) of the SRBC regulations states that compensation shall be required for consumptive use from aquifers hydraulically related to stream flows when the stream flow is less than the applicable low flow criterion.

Table 3 summarizes the occurrence of flows at or below the Q7-10 value at key gages in the West Branch Susquehanna River Subbasin. The table gives calculated Q7-10 values, and compares the period of record examined with the number of years that flows less than or equal to these values occurred. For example, the table indicates that the period October 1913-September 1986 was examined for gaging station number 01541000 on the West Branch Susquehanna River at Bower, Pa. At least one average daily flow of 25.9 cfs or less (the Q7-10 value) was recorded in twelve of those years.

3. Ground Water

Ground water makes up about 65 percent of stream flows in the West Branch Susquehanna River Subbasin during average conditions (Taylor and others, 1983) and nearly all stream flows during low flow conditions. Little ground-water recharge occurs during the summer and early fall, when most precipitation is lost through evapotranspiration.

During the summer, there is normally a steady lowering of water levels. Although the greatest recharge generally occurs in March and April, some recharge also occurs during late fall after most vegetation has died, but before the ground is frozen.

Seasonal variation in precipitation is more critical to ground-water levels than the annual total. A dry spring or fall could have considerably more effect than a dry summer.

TABLE 3

OCCURRENCE OF 7-DAY 10-YEAR LOW FLOW
VALUE AT KEY GAGES

USGS Station No.	Stream & Location	Q7-10 (cfs)	Gage Record Examined	No. Years Occurred
01541000	W. Br. Susq. R. at Bower, Pa.	25.9	10/13-09/86	12
01542500	W. Br. Susq. R. at Karthaus, Pa.	144.1	03/40-09/86	8
01543500	Sinnemahoning Crk. at Sinnemahoning, Pa.	12.9	10/38-09/86	8
01548000	Bald Eagle Crk. at Beech Crk. Station, Pa.	116.7	07/10-09/85	12
01551500	W. Br. Susq. R. at Williamsport, Pa.	468.9	03/1895-01/87	12
01552000	Loyalsock Crk. at Loyalsockville, Pa.	22.1	10/25-09/86	6
01553500	W. Br. Susq. R. at Lewisburg, Pa.	665.4	10/39-01/87	8

The distribution and abundance of ground water in the subbasin depend on the properties of the subsurface materials in which the water occurs. Aquifers in the subbasin are a thick sequence of sedimentary rocks consisting primarily of sandstone, siltstone, shale, and limestone. The rock strata are generally folded in the area of the subbasin within the Valley and Ridge physiographic province (Figure 3), but are relatively flat-lying in the Appalachian Plateaus physiographic province.

Well yields are influenced by the type of rock, topography, and geologic structure. The water-bearing properties of stratigraphic units occurring in the subbasin are discussed in detail by Taylor and others (1983). In general, yields from carbonate rocks (limestone and dolomite) are consistently higher than those from sandstone, which in turn have consistently higher yields than shale. Wells located in valleys, gullies, and other lower lying areas generally produce greater yields than hillside and hilltop wells. Faults, folds, fractures, and bedrock dips are geologic structures that have an important influence on well yields.

The water table generally forms a subdued replica of the land surface. Depth to ground water is generally least in valleys and low lying areas, greater under hillsides, and greatest under hilltops. Median depths to ground water in each of the above settings are 18, 55, and 80 feet, respectively.

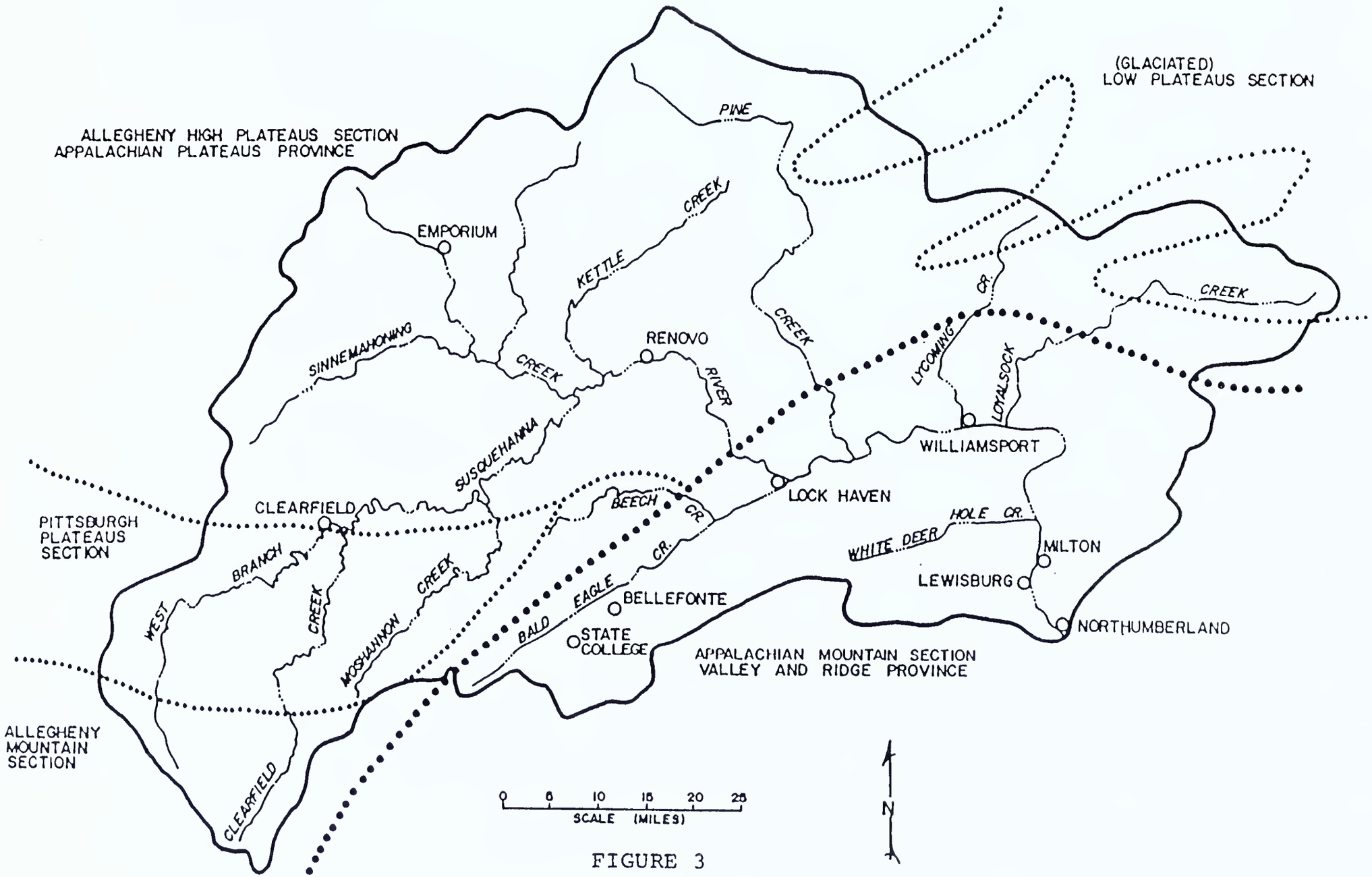


FIGURE 3

Geological Divisions of the
West Branch Susquehanna River Subbasin

4. Surface Water/Ground-Water Interaction

Ground water is in constant motion from points of recharge to points of discharge, which are springs and streams. Any withdrawal from ground water may alter stream flows at some later date.

If the water table in an aquifer is lowered to a level less than the water level in a stream crossing the aquifer, stream water may infiltrate into the aquifer. Recharge of the aquifer may be induced when the pumping of a well located near a stream alters the natural water-table gradient so that water moves from the stream to the well.

If water withdrawn from a well is returned to a stream, the net effect would be to provide a more direct route to the stream by way of the discharge pipeline. If pumping is continuous, the stream depletion rate approaches the pumping rate. The impact of the ground-water withdrawal on the stream will be determined by how and where the water is returned to the stream. If pumping is seasonal and occurs only during a dry period, it is possible that the major part of the stream depletion caused by pumping will come after the low flow period. However, if the well is located very close to the stream, the effect may essentially be the same as a direct diversion, and there would be no benefit during low flow periods.

5. Water Quality

A water quality and biological survey of the West Branch Susquehanna River was conducted by the SRBC (McMorran, 1985). The most important factor affecting water quality in the subbasin is acid mine drainage. The 50-mile reach of river between the headwaters of the West Branch and the mouth of Chest Creek has severe acid mine drainage and sewage pollution problems. Although better water quality is found in the 37-mile stretch of river between Chest Creek and Clearfield, the effects of upstream pollution are still apparent in the form of high levels of many chemical parameters. The 104-mile reach of river between Clearfield and the mouth of Bald Eagle Creek is severely degraded due to acid mine drainage, and is generally devoid of aquatic life. Bald Eagle Creek enters the West Branch just downstream of Lock Haven and contributes a very large amount of alkalinity that serves to neutralize the acidity in the West Branch. The river recovers to the point that good water quality is found from Jersey Shore to the mouth of the West Branch at Northumberland.

Water quality varies in the tributaries to the West Branch. Acid mine drainage causes degradation in the following tributaries: Bennett Branch Sinnemahoning Creek, Cush Creek, Bear Run, Anderson Creek, Clearfield Creek, Surveyor Run, Lick Run, Deer Creek, Alder Run, Moshannon Creek, Mosquito Creek, Kettle Creek, Drury Run and Cooks Run. The remaining eighteen tributary streams surveyed in the subbasin displayed good water quality.

Ground water was also studied in the area. The Pa. DER conducted a study of the ground-water resources of the West Branch (Taylor and others, 1983) which compiled a large volume of information on the quantity and quality of ground-water within the West Branch region. Ground water in the region varied from area to area and ranged from soft to moderately hard with low to moderate amounts of dissolved solids. The most common ground-water quality problems identified were: excessive iron & manganese, hydrogen sulfide, hardness, bacterial organisms from sewage, acid mine drainage, petroleum products from buried storage tanks, excessive nitrates, and landfill leachate. Most of these problems are local in extent and are often confined to individual wells or a small area.

6. Recreation

Water is an important recreational resource. Water-based recreational activities such as swimming, fishing, and boating are very popular throughout the West Branch Susquehanna River Subbasin. The subbasin provides some of the finest recreational opportunities in the state. The demand for water-based recreation is projected to grow steadily in the future (Pa. DER, 1986b).

Excellent fishing opportunities are available in the subbasin. The Pennsylvania Fish Commission (PFC) stocks numerous tributary streams with trout. A number of wild trout streams are also located in the subbasin (PFC, Trout Fishing in Pennsylvania). The region also offers area fisherman with

numerous warmwater fishing opportunities. Twenty-four state parks are located in the subbasin and provide facilities for swimming, fishing, and boating.

C. POPULATION

The West Branch Susquehanna River Subbasin is not densely populated. Comparison of 1970 and 1980 census data indicates that the subbasin experienced an 8.4 percent increase in population between 1970 and 1980. The subbasin's population is expected to continue to increase. Population statistics are listed in Tables 4 and 5.

TABLE 4

POPULATION STATISTICS

Area	1980 Population	1970 Population	Percent Change
W. Br. Susq. R. Subbasin	454,507	419,258	+8.4
Cameron Co.	6,674	7,096	-5.9
Centre Co.	112,760	99,267	+14.0
Clearfield Co.	83,578	74,619	+12.0
Clinton Co.	38,971	37,721	+3.3
Lycoming Co.	118,416	113,296	+4.5
Potter Co.	17,726	16,395	+8.1
Sullivan Co.	6,349	5,961	+6.5
Union Co.	32,870	28,603	+14.9
Williamsport	33,401	37,918	-11.9
Lock Haven	9,617	11,427	-15.8
State College	36,130	33,778	+7.0
Clearfield	7,580	8,176	-7.3

Based on Pa. DER (1985).

TABLE 5

POPULATION PROJECTIONS

Area	1980	1990	2000	2010
W. Br. Susq. R. Subbasin	454,507	464,830	471,400	477,730
Cameron Co.	6,674	6,768	6,863	6,962
Centre Co.	112,760	114,905	115,999	117,016
Clearfield Co.	83,578	85,655	87,030	88,293
Clinton Co.	38,971	39,820	40,475	41,129
Lycoming Co.	118,416	120,856	122,500	124,180
Potter Co.	17,726	18,309	18,694	19,047
Sullivan Co.	6,349	6,557	6,699	6,827
Union Co.	32,870	33,819	34,359	34,860
Williamsport	33,401	33,290	33,438	33,737
Lock Haven	9,617	9,545	9,584	9,668
State College	36,130	35,683	35,398	35,150
Clearfield	7,580	7,617	7,718	7,811

Based on Pa. DER (1985).

D. LAND USE

The West Branch Susquehanna River Subbasin has large areas of undeveloped land. About 81 percent of the subbasin area is forest (Pa. DER; 1979a, 1979b, and 1980). About 12 percent of the subbasin is agricultural or open land. Only about 3 percent of the area is urban land, while about 4 percent falls into other land use categories.

The Williamsport area is the largest urban and industrialized center in the subbasin. State College is less industrialized but is second largest, primarily due to the presence of the Pennsylvania State University. Lock Haven and Clearfield are the third and fourth largest population centers in the subbasin.

In the future, the amount of agricultural land is expected to decrease, while forest land may decrease slightly and urban land may increase slightly (Pa. DER; 1979a, 1979b, and 1980). The amount of land used for other purposes is expected to increase significantly and may double by the year 2020.

E. BUSINESS AND INDUSTRY

The West Branch Susquehanna River played a major role in the early industrial development of the subbasin. It provided downstream transport for logs and was critical to the development of lumbering, the first major industry in the subbasin. It also provided water for the West Branch Division of the Pennsylvania

Canal, which was opened in 1833 and ran between Northumberland and Lock Haven (Lycoming County Planning Commission, 1975). The canal became obsolete when rail service was extended to Lock Haven in 1856.

By the mid 1800's, Williamsport had emerged as a major supplier of lumber to the developing nation. Logs were collected in a huge boom at Williamsport to serve over thirty area sawmills. Smaller booms were also constructed at Lock Haven and Jersey Shore. Other communities developed as trading centers to serve the lumber industry. Much of the lumber produced was shipped to eastern markets by rail.

Logging in the area declined by the late 1800's, primarily due to depletion of the timber resource. Floods at Williamsport in 1860, 1861, and 1889 caused considerable damage to the log boom and sawmills, hastening the decline of the industry.

Today, much of the subbasin is reforested, and there is enough timber of suitable quality to support a limited lumber industry. Manufacturing is the dominant industry, and is concentrated in and around Williamsport, Lock Haven, and Clearfield. Coal mining is important in the southwest portion of the subbasin. Farming is most profitable in the more level areas which are generally located along major streams. Education is an important service industry, with colleges and/or universities

being located at State College, Lock Haven, Lewisburg, Williamsport, and Loretto.

Employment statistics for the subbasin are contained in Table 6. In 1985, the estimated per capita income for the subbasin was $8,264, which was below the statewide estimate of $10,288 (Pennsylvania State Data Center, 1987).

F. SUBBASIN SECTIONS

The following sections of the West Branch Susquehanna River Subbasin are discussed separately in this framework plan with respect to water use and low flow events:

1. Sinnemahoning Creek
2. West Branch Susquehanna River above Clearfield Creek
3. Clearfield Creek and West Branch Susquehanna River from Clearfield Creek to Moshannon Creek
4. Moshannon Creek and West Branch Susquehanna River from Moshannon Creek to Sinnemahoning Creek
5. Bald Eagle Creek
6. West Branch Susquehanna River from mouth of Sinnemahoning Creek to and including Pine Creek
7. West Branch Susquehanna River from mouth of Pine Creek to and including Lycoming Creek
8. Loyalsock Creek
9. West Branch Susquehanna River below Lycoming Creek except Loyalsock Creek

TABLE 6

WEST BRANCH SUSQUEHANNA RIVER SUBBASIN
EMPLOYMENT BY MAJOR INDUSTRY GROUPS (1983)

Employment Category	Percent of Total Employment
Agricultural Services, Forestry, Fisheries	0.2
Mining	3.3
Construction	3.6
Manufacturing	32.6
Transportation & Public Utilities	5.4
Wholesale Trade	4.0
Retail Trade	22.1
Finance, Insurance & Real Estate	4.8
Services	23.5
Other	0.5

Based on U.S. Dept. of Commerce (1985).

A map showing the approximate boundaries of the above sections is included as Figure 4.

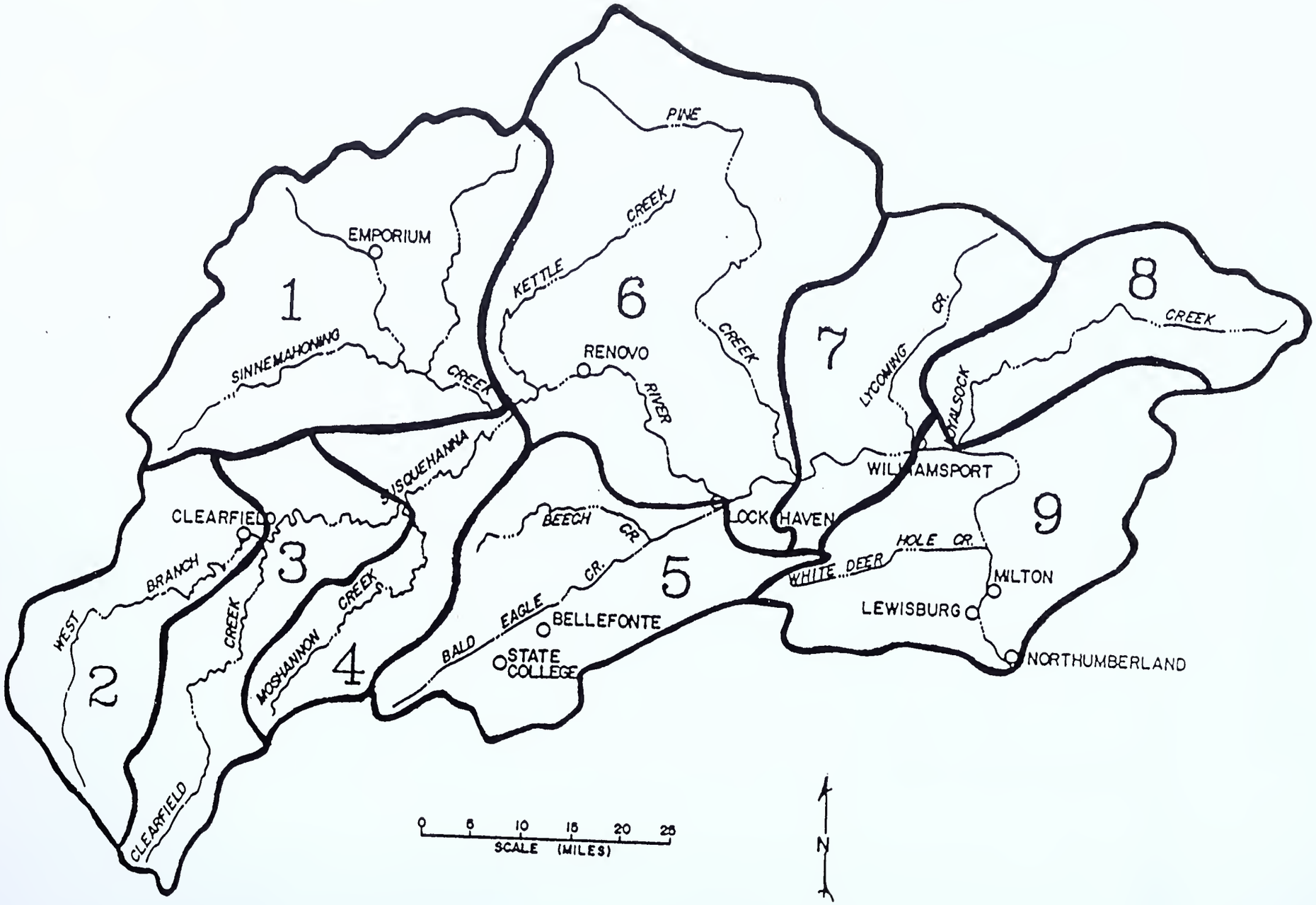


FIGURE 4

SECTIONS OF THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

III. METHODOLOGY FOR WATER USE CALCULATIONS

A. GENERAL

Water use data for the West Branch Susquehanna River Subbasin were derived from existing inventories and surveys, which were also used to project future water use. Water use estimates contained in this report focus upon potential demands during low flow conditions.

This framework plan uses the Q7-10 value as a target to allow comparison of potential water deficits during a low flow event. The Q7-10 is used for comparison purposes and is not considered to be a minimum flow which must be maintained.

Consumptive water uses are significant, since they remove water from the stream or aquifer and make it unavailable for immediate re-use in downstream areas. Steam electric generating facilities and other industries whose operations result in water losses are considered consumptive users. However, a portion of domestic water supply is also consumed (lost). Lawn or garden watering results in losses to evapotranspiration. Additional losses may occur due to car washing, clothes drying, and other domestic uses. During low water periods, the cumulative effects of consumptive losses become more important.

B. MUNICIPAL WATER USE

Estimates of municipal water use in the West Branch Susquehanna River Subbasin were obtained from the State Water Use

Data System maintained by the State Water Plan Division of the Pa. DER. Water use data for large, self-supplied institutions such as universities, correctional facilities, and state parks were also obtained and included with municipal water use estimates. Baseline water use data for each system are included in this framework plan. Water use projections for each subbasin section are presented for the years 1990, 2000, and 2010.

Estimating the quantity of water consumed due to municipal withdrawals is difficult. Consumptive use rates vary locally, and are dependent on the kinds of industrial uses, the condition of the water supply conveyance system, and the standards of living and habits of domestic water users.

One method of calculating consumptive use for a particular municipality involves estimating the amount of water withdrawn by the water supply system and subtracting the amount discharged through the municipality's sewage treatment plant. However, the geographic areas served by water supply and sewer systems do not necessarily coincide. Also, some users may use one system and not the other. For example, an industry may have its own water supply, yet be connected to the municipal sewer system.

The above methodology is further complicated by the fact that most water systems experience some leakage. Also, sewer systems can experience some infiltration from ground water during wet periods, and exfiltration during dry periods. Both of these

processes vary from system to system and further complicate consumptive use calculations.

The Pa. DER State Water Plan Division uses the value of 10 percent as an estimate of consumptive use by municipal systems. Preliminary studies of the Carlisle and Red Lion, Pa. water supply systems by SRBC staff indicate that consumptive use by these communities ranged up to 20 percent of their total withdrawals depending on time of year. A consumptive loss estimate of 20 percent was considered applicable during late summer low flow periods. This value agrees closely with the estimated value of 22 percent consumption cited by Dunne and Leopold (1978) as a national average for municipal systems in the United States. The U.S. Geological Survey (Solley and others, 1983) has estimated that this national average is about 21 percent. For the purpose of this low flow management framework plan, the consumptive use estimate for municipal systems was calculated by multiplying the average annual daily use value by 20 percent.

C. SELF-SUPPLIED INDUSTRIAL WATER USE

Water use data for self-supplied industries including mining operations were also derived from the State Water Use Data System maintained by the State Water Plan Division of the Pa. DER. The general trends in economic activity in Pennsylvania were compared for twenty major two-digit Standard Industrial Classification (SIC) code groups. Water use data were also obtained for anthracite and bituminous coal mining activities in Pennsylvania. Economic trends in coal production were also examined.

Water use was assumed to be proportional to the value added to the product by the manufacturer. The figures for the value added by the manufacturer were obtained from the Census of Manufacturers for the years 1958, 1963, 1967, 1972, 1977, and 1982. These values were adjusted to 1972 constant dollars using an implicit price deflator determined from the 1984 Economic Report of the President. Figures for value added by manufacturer were not available for coal production. Therefore, water use was assumed proportional to tons of coal mined. Values for tons of coal produced were obtained from the Pa. DER's 1986 Annual Report on Mining Activities for the years 1951, 1956, 1961, 1966, 1971, 1976, 1981, and 1986 (Pa. DER, 1986a).

The above values were plotted against their corresponding years and the projected values for the years 1990, 2000, and 2010 were determined using least squares analysis. Ratios of the projected values to the base year 1980 for each industrial group were multiplied by the particular industry's water use in 1980. The result was the projected water use for the corresponding year. Appendix A includes a table showing the ratio of the projected value added to the base year 1980 for each industrial group that showed increasing economic activity.

Any given industry may show economic activity that is different from the general trends for its related SIC group. Therefore, for the purpose of this framework plan, the 1980 water use for any industry within a declining industrial category was

assumed constant over the projected years of 1990, 2000, and 2010. Water use for the growth industries was estimated by using the water use increase ratio as previously stated. The industrial projections cited in this report should be considered as worst case estimates of future water use.

Consumptive use data for self-supplied mineral and non-mineral industries were calculated using a consumptive water use index developed by the Pa. DER State Water Plan Division. This index lists industries by SIC code and gives estimated consumptive use as a percentage of each industry's total water use (Appendix A). Values for the index were obtained from the U.S. Department of Commerce's Census of Manufactures - Water Use in Manufacturing.

D. SELF-SUPPLIED DOMESTIC WATER USE

Because individual domestic wells generally provide only limited supplies, estimates of self-supplied domestic use were not calculated and were not considered essential for the development of this framework plan. Further, domestic wells often may be located where the potential for effects on stream flows is minimal.

E. DIVERSIONS

The previously cited DuBois diversion is an out-of-basin transfer that was implemented prior to the Susquehanna River Basin Compact. The SRBC's Comprehensive Plan specifies that this

diversion is to be protected. Since the effects of the diversion are included in the long term hydrologic records for downstream gaging stations, no hydrologic analyses of the diversion were performed. The diversion was not included in the tally of total and consumptive water uses for the subbasin.

F. AGRICULTURAL WATER USE

Irrigation and livestock data were used to estimate daily agricultural water demands. Although minor quantities of water are used for the application of herbicides, fungicides, insecticides, and fertilizers, these applications are generally performed early in the year, prior to the development of low flow conditions. Water used for these applications was not considered essential to development of this framework plan.

Agricultural water use estimates in this report were calculated from limited data using many assumptions. Additional difficulties arose in attempting to predict future agricultural water use. Changes in farming practices and market conditions are inevitable and could grossly affect both irrigation and livestock water use. For the purpose of this framework plan, livestock data for the year showing the greatest number of livestock were considered to be representative of potential livestock demands during low stream flow conditions through the year 2010. Irrigation data for the year showing the greatest irrigation water use were considered to be representative of potential irrigation demands through the year 2010.

1. Livestock Water Use

Livestock data for Cambria, Cameron, Centre, Clearfield, Clinton, Elk, Lycoming, Montour, Northumberland, Potter, Sullivan, Tioga, and Union Counties were obtained from the U.S. Censuses of Agriculture for 1982, 1978, 1974, 1969, and 1964. Daily water use requirements per animal were obtained from a publication by the Midwest Plan Service (1979). These daily water use estimates agreed closely with similar estimates cited in the Pennsylvania State Water Plan (Pa. DER, 1975). Total water use by livestock was calculated by multiplying the daily water use per animal by the number of animals. Consumptive use of water by livestock was considered to average about 75 percent, as reported by Dunne and Leopold (1978) and the Pennsylvania State Water Plan. Livestock water use estimates for the counties referenced above are included in Appendix C.

The methodology for estimating potential livestock water use included the following steps.

a. Water use per unit area was calculated for each county;

b. The area of each county in each stream section was determined;

c. Appropriate values from step a. were multiplied by values from step b. to calculate the water use for the areas of each county in each stream section; and

d. Appropriate values from step c. were summed to determine water use for each stream section.

2. Irrigation

Irrigation water use was estimated using a methodology similar to that described in the Pennsylvania State Water Plan (Pa. DER, 1975). Farmland acreages and irrigation data were obtained from the U.S. Censuses of Agriculture for each county referenced above. Average daily water use for irrigation during each census year was estimated by first multiplying the number of acres irrigated by 1/2 inch of water applied per week during the irrigation season and then converting the units to gallons per day.

A large percentage of irrigation water is lost due to evaporation and transpiration by plants. The Pennsylvania State Water Plan (Pa. DER, 1975) estimated that about 100 percent of the water used for irrigation is consumed. On the basis of computer model simulations for 2 crops (potatoes and small vegetables), Kibler and others (1977) calculated a seasonal, crop-weighted average consumptive use value of about 82.5 percent. Data from Dunne and Leopold (1978) for the entire United States suggest that consumptive losses associated with irrigation average about 81 percent. A consumptive use coefficient of about 85 percent was cited by Steenhuis and others (1986) for the Susquehanna River Basin in New York State. For the purpose of this framework plan, consumptive use of irrigation water was considered to average about 85 percent of the total irrigation water used.

County irrigation data are included in Appendix C. County irrigation data were used to calculate irrigation in each stream section using the same methodology described previously in the Livestock Water Use section above.

G. COMPUTATION OF STORAGE REQUIRED TO MAINTAIN THE Q7-10 VALUE

The amount of reservoir storage that would be required to maintain the Q7-10 value considering future consumptive losses was computed as follows (Section XIII.B.):

a. Historical data for the following stream gages were used to calculate flows at the outlets of the subbasin sections:

- No. 01541000, W. Br. Susquehanna River at Bower
- No. 01542500, W. Br. Susquehanna River at Karthaus
- No. 01543500, Sinnemahoning Crk. at Sinnemahoning
- No. 01548000, Bald Eagle Crk. at Beech Creek Station
- No. 01551500, W. Br. Susquehanna River at Williamsport
- No. 01552000, Loyalsock Crk. at Loyalsockville
- No. 01553500, W. Br. Susquehanna River at Lewisburg

b. Q7-10 values were determined for each of these gages using standard USGS procedures;

c. Critical low flow periods were determined from the records for each gage;

d. Daily streamflows for the critical periods were extracted from the USGS WATSTORE computer files, and adjusted for effects of increased or decreased drainage area either downstream or upstream from the gage by using drainage area ratios; the Q7-10 values were similarly adjusted;

e. The total upstream consumptive use (C) was added to the adjusted Q7-10 value to obtain the subarea value of Q7-10+C;

f. If the natural flow on any day was less than the daily value of Q7-10+C, the difference was computed and accumulated for the climatic year (ending March 30) in order to determine storage.

Initially, data from the Karthaus gage were used to calculate storage requirements at the outlets of Sections 3 and 4. Data from the Lewisburg gage were initially used to calculate storage requirements at the mouth of the subbasin. However, the periods of record for the Karthaus and Lewisburg gages do not include the 1930 climatic year, which other gaging station records indicate to be the most critical period for the main stem of the West Branch Susquehanna River. Therefore, storage requirements for the outlets of Sections 3, 4, and 9 were recalculated using other mainstem gaging stations with records that included the 1930-31 drought event.

It should be noted that due to different periods of record for different gaging stations, as well as differing geologic, climatic, and hydrologic conditions from site to site, calculated Q7-10 values based on historic records cannot simply be added along the length of the subbasin. The calculated Q7-10 value for the West Branch Susquehanna River at its mouth is not necessarily equal to the sum of the calculated Q7-10 values for all tributaries upstream of that point.

IV. SUBBASIN SECTION 1

SINNEMAHONING CREEK

A. WATER USE

1. Municipal Water Use

Table 7 summarizes baseline water use data for the nine public water suppliers withdrawing water from Section 1. Total and consumptive use estimates through the year 2010 are summarized in Table 8. Public water supply data obtained from the Pa. DER indicate that total average daily water use under baseline conditions is about 0.89 MGD. Total projected demand on public systems is expected to decrease to about 0.88 by 1990, and then to decline to about 0.84 MGD by the year 2010 due to projected changes in population. The calculated total consumptive use for public systems under baseline conditions is 0.18 MGD, while projected consumptive use by the year 2010 is 0.17 MGD.

2. Self-Supplied Non-Mineral Industrial Water Use

Total water demand and consumptive use estimates for self-supplied industries other than mining are summarized in Tables 9 and 10. Total industrial water use is expected to increase slightly through the year 2010, but remain near 0.03 MGD. Consumptive use by self-supplied industries is estimated at less than 0.01 MGD.

3. Self-Supplied Mineral Industrial Water Use

Total water demand and consumptive use estimates for self-supplied mineral industries are summarized in Tables 11 and 12.

TABLE 7

BASELINE MUNICIPAL WATER USE DATA FOR SECTION 1
OF THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

Municipal System Name	Source	Pop. on System	Avg. Water Use (gpd)	GPCD	Peak Water Use (gpd)	Peak/Avg. Ratio
Austin Boro Waterworks	SW,GW	740	90,000	121.6	135,000	1.50
Driftwood Boro Water Co.	SW	238	14,390	60.5	21,585	1.50
Emporium Water Co.	SW	4,274	532,000	124.5	798,000	1.50
Fox Homes Improvement Assn.	GW	640	49,500	77.3	67,815	1.37
Huston Twp. Water Auth.	SW	856	41,200	48.1	61,800	1.50
Jay Twp. Water Auth.	SW	542	48,200	89.0	69,890	1.45
New Shawmut Homes, Inc.	SW	352	28,000	79.6	42,000	1.50
Sizerville State Park*	GW,SW		4,200			
Weedville Water Assn.	SW	1,194	81,100	67.9	90,021	1.11
TOTAL		8,836	888,590		1,290,311	

* No population, GPCD, water use projections, or peak value data available.

Key to Abbreviations:

SW-Surface Water
GW-Ground Water

gpd-gallons per day
GPCD-gallons per capita per day

TABLE 8

MUNICIPAL WATER USE PROJECTIONS FOR SECTION 1

Parameter	Base	1990	2000	2010
Population Served	8,836	8,880	8,722	8,612
Avg. Daily Water Use (gpd)	888,590	882,260	854,750	840,530
Consumptive Use (gpd)	177,718	176,452	170,950	168,106
Peak Water Use (gpd)	1,290,311	1,279,766	1,238,525	1,218,112

TABLE 9

NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 1
TOTAL USE

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Don & Verns Machine Co.	GW	4	4	4	4
Elcam Tool & Die	GW	288	288	288	288
Gerg Tool & Die Co.	GW	480	480	480	480
Lewis & Hockenberry	GW	3,000	3,930	4,230	4,530
Mallery Lumber Corp.(1)	GW	1,600	1,600	1,600	1,600
Mallery Lumber Corp.(2)	SW	16,000	16,000	16,000	16,000
Pa. Pressed Metals(1)	GW	42	42	42	42
Pa. Pressed Metals(2)	SW	4,190	4,190	4,190	4,190
Total		25,604	26,534	26,834	27,134

TABLE 10

NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 1
CONSUMPTIVE USE

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Don & Verns Machine Co.	0	0	0	0
Elcam Tool & Die	12	12	12	12
Gerg Tool & Die Co.	20	20	20	20
Lewis & Hockenberry	0	0	0	0
Mallery Lumber Corp.(1)	123	123	123	123
Mallery Lumber Corp.(2)	1,230	1,230	1,230	1,230
Pa. Pressed Metals(1)	3	3	3	3
Pa. Pressed Metals(2)	259	259	259	259
Total	1,647	1,647	1,647	1,647

TABLE 11

MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 1
TOTAL USE

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Glen Irvan Corp.	GW	95	95	95	95
Lady Jane Collieries(1)	GW	18,400	18,400	18,400	18,400
Lady Jane Collieries(2)	GW	164,000	164,000	164,000	164,000
P&N Coal Co.	GW	40,000	40,000	40,000	40,000
Sinnemahoning Gravel	GW	15,000	15,000	15,000	15,000
TOTAL		237,495	237,495	237,495	237,495

TABLE 12

MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 1
CONSUMPTIVE USE

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Glen Irvan Corp.	17	17	17	17
Lady Jane Collieries(1)	3,280	3,280	3,280	3,280
Lady Jane Collieries(2)	29,300	29,300	29,300	29,300
P&N Coal Co.	7,140	7,140	7,140	7,140
Sinnemahoning Gravel	783	783	783	783
TOTAL	40,520	40,520	40,520	40,520

No increase in water use by self-supplied mineral industries was projected for the section. Total water use was estimated to be 0.24 MGD, with about 0.04 MGD consumed.

4. Agricultural Water Use

The methodology described in Section III.F. of this report was used to calculate a livestock water use estimate of 0.17 MGD and an irrigation water use estimate of 0.02 MGD. Livestock and irrigation consumption are estimated to be 0.13 MGD and 0.01 MGD, respectively.

5. Summary of Water Use in Subbasin Section 1

Estimates of water use for the section are listed in Tables 13 and 14. Water use values are given in both MGD and cubic feet per second (cfs) to facilitate comparison with stream flows discussed in subsequent chapters. The water use totals cited at the bottom of Tables 13 and 14 are representative of potential, rather than actual conditions.

B. OCCURRENCE OF Q7-10 VALUE

Table 15 and Figures 5 and 6 summarize the occurrence of flows at or below the Q7-10 value in Sinnemahoning Creek at Sinnemahoning. Flows at or below the Q7-10 value have been documented in August and September of various years. Flows of this magnitude occurred during more days in 1939 than in any other year of record.

TABLE 13

TOTAL WATER USE SUMMARY FOR SECTION 1*

User	Total Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	0.89	0.88	0.85	0.84
Industrial				
Non-Mineral Self-Supplied	0.03	0.03	0.03	0.03
Mineral Self-Supplied	0.24	0.24	0.24	0.24
Agriculture				
Livestock	0.17	0.17	0.17	0.17
Irrigation	0.02	0.02	0.02	0.02
TOTAL	1.35	1.34	1.31	1.30
	(2.09 cfs)	(2.07 cfs)	(2.03 cfs)	(2.01 cfs)

* Assuming potential low flow conditions.

TABLE 14

CONSUMPTIVE WATER USE SUMMARY FOR SECTION 1*

User	Consumptive Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	0.18	0.18	0.17	0.17
Industrial				
Non-Mineral Self-Supplied	<0.01	<0.01	<0.01	<0.01
Mineral Self-Supplied	0.04	0.04	0.04	0.04
Agriculture				
Livestock	0.13	0.13	0.13	0.13
Irrigation	0.01	0.01	0.01	0.01
TOTAL	0.36	0.36	0.35	0.35
	(0.56 cfs)	(0.56 cfs)	(0.54 cfs)	(0.54 cfs)

* Assuming potential low flow conditions.

TABLE 15

FLOWS AT OR BELOW THE 7-DAY 10-YEAR LOW FLOW VALUE
FOR SINNEMAHONING CREEK AT SINNEMAHONING, PA.
(USGS SITE NO. 01543500)

Calendar Year	No. of Days Occurred	Months Occurred/ No. Days Per Month
1939	18	Aug./5, Sept./13
1949	2	Aug./2
1951	3	Aug./2, Sept./1
1952	4	Sept./4
1953	4	Sept./4
1954	4	Sept./4
1955	1	Sept./1
1957	4	Sept./4
TOTAL	40	Aug./9, Sept./31

FIGURE 5

NUMBER OF DAYS 7-DAY 10-YEAR LOW FLOW OCCURRED DURING PERIOD 1938 – 1986 SINNEMAHONING CREEK @ SINNEMAHONING

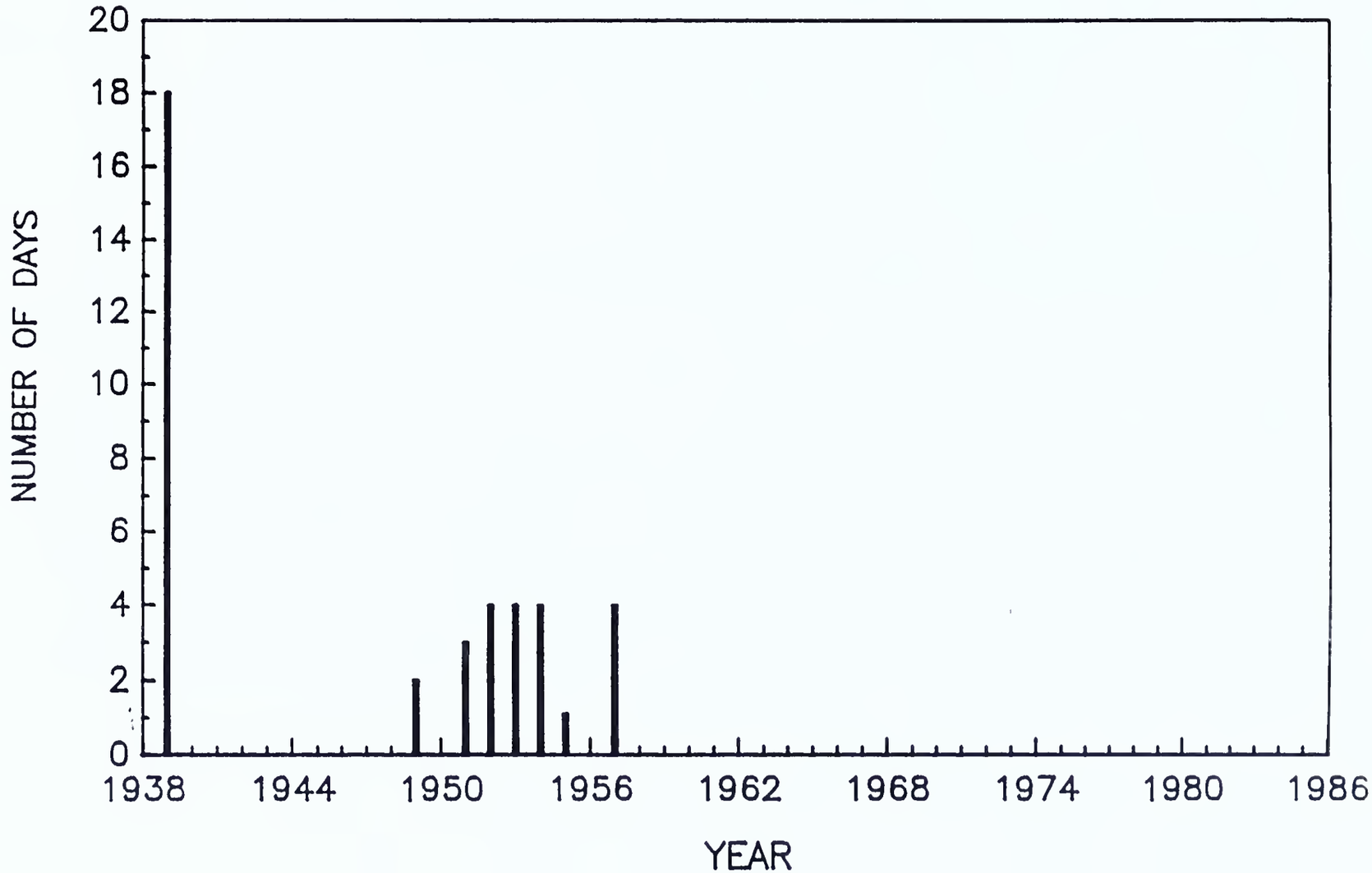
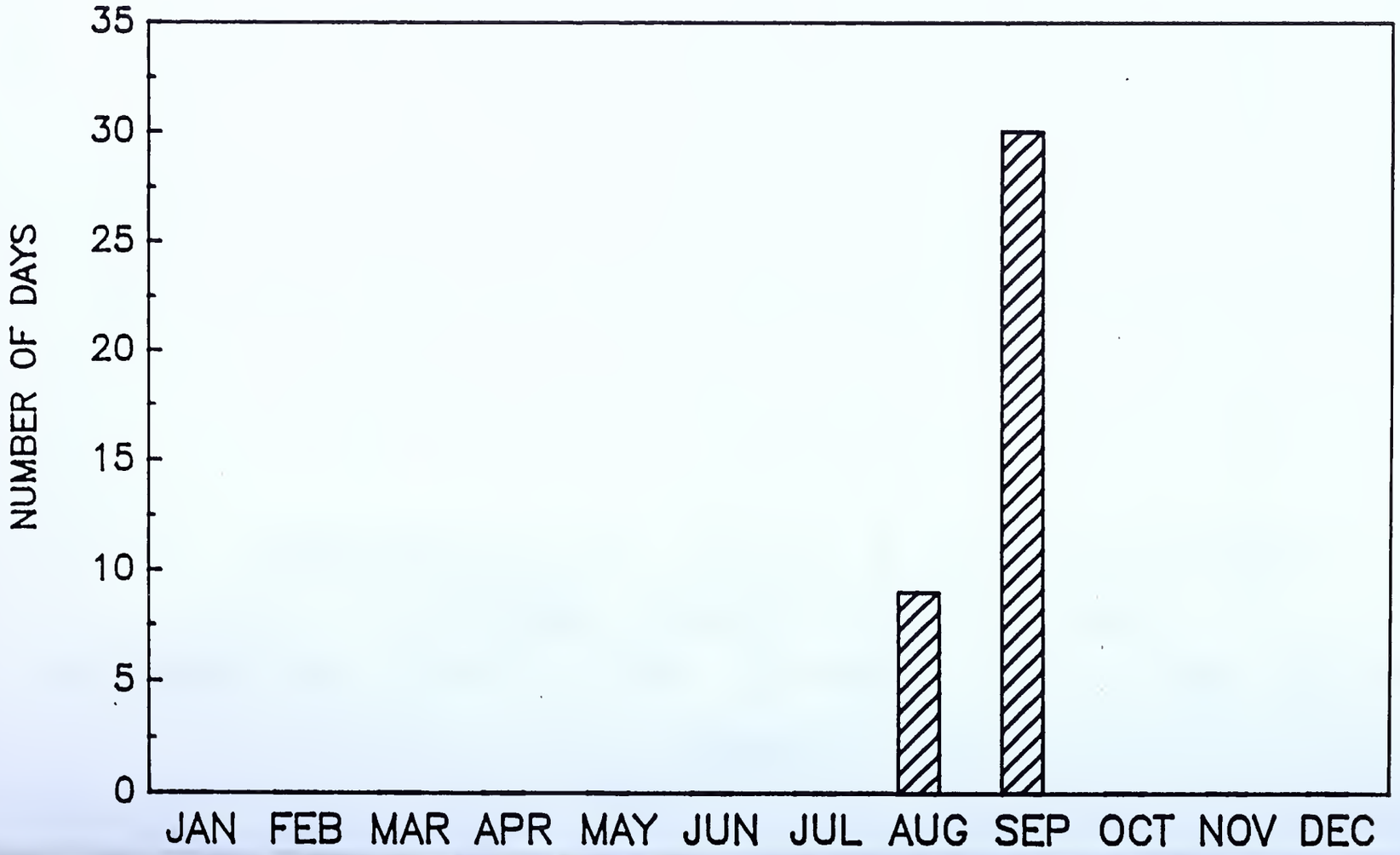


FIGURE 6

NUMBER OF DAYS 7-DAY 10-YEAR LOW FLOW OCCURRED
IN EACH MONTH
SINNEMAHONING CREEK @ SINNEMAHONING
(FOR PERIOD 1938 – 1986)



V. SUBBASIN SECTION 2

WEST BRANCH SUSQUEHANNA RIVER ABOVE CLEARFIELD CREEK

A. WATER USE

1. Municipal Water Use

Baseline water use data for the sixteen public water suppliers withdrawing water from Section 2 are summarized in Table 16. Water use projections for the section are summarized in Table 17. Total water use is expected to decrease from the baseline estimate of 4.25 MGD to 4.02 MGD by 2010. Consumption is estimated to be 0.85 MGD under baseline conditions and 0.80 MGD in 2010.

2. Self-Supplied Non-Mineral Industrial Water Use

Total water demand and consumptive use data for self-supplied industries in Section 2 are summarized in Tables 18 and 19. None of the self-supplied industries in the section fell into a SIC code classification representing a growing industry. Total and consumptive use through 2010 are estimated to be 0.14 MGD and 0.01 MGD, respectively.

3. Self-Supplied Mineral Industrial Water Use

Water use by mineral industries is greater in Section 2 than in any other section of the West Branch Susquehanna River Subbasin. Bituminous coal mining and processing operations account for most of the water used by mineral industries in the section.

TABLE 16

BASELINE MUNICIPAL WATER USE DATA FOR SECTION 2
OF THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

Municipal System Name	Source	Pop. On System	Avg. Water Use (gpd)	GPCD	Peak Water Use (gpd)	Peak/Avg. Ratio
Barnesboro Water Co.	GW,SW	2,953	390,600	132.4	636,678	1.63
Burnside Boro Municipal Auth.	GW	347	13,600	39.2	20,400	1.50
Carroltown Water Dept.	GW,SW	1,441	171,430	118.7	204,002	1.19
Cherry Tree Boro Municipal Auth.	SW	400	50,060	125.0	75,090	1.50
Clearfield Mun. Water Authority	SW	13,574	2,135,000	157.6	2,818,200	1.32
Elder Twp. Authority	GW	186	12,000	64.5	18,000	1.50
Glen Campbell Mun. Waterworks	GW	336	38,300	114.0	103,027	2.69
Hastings Boro Authority	GW	1,987	218,100	109.7	270,444	1.24
Indiana Co. Mun. Services Auth. Arcadia	SW	95	6,440	67.8	28,980	4.50
Marsteller Mun. Water Auth.	GW	194	30,100	155.1	40,635	1.35
Patton Waterworks	SW	2,708	415,000	153.2	1,120,500	2.70
Pike Twp. Mun. Auth.	SW	3,696	384,600	104.1	576,900	1.50
Spangler Mun. Authority	GW,SW	2,279	210,000	92.1	258,300	1.23
W. Carrol Twp. Water Auth.- Bakerton	SW	748	107,000	143.0	160,500	1.50

Municipal System Name	Source	Pop. On System	Avg. Water Use (gpd)	GPCD	Peak Water Use (gpd)	Peak/Avg. Ratio
W. Carrol Twp. Water Auth.- St. Benedict	SW	312	46,000	147.5	69,000	1.50
Westover Mun. Authority	SW	342	20,000	58.5	20,000	1.00
Total		31,598	4,248,230		6,420,656	

TABLE 17

MUNICIPAL WATER USE PROJECTIONS FOR SECTION 2

Parameter	Base	1990	2000	2010
Population Served	31,598	30,575	29,790	29,629
Avg. Daily Water Use (gpd)	4,248,230	4,120,880	4,030,820	4,018,490
Consumptive Use (gpd)	849,646	824,176	806,164	803,698
Peak Water Use (gpd)	6,420,656	6,177,030	5,993,477	5,950,781

TABLE 18

NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 2
TOTAL USE

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
AAA Capacitor	GW	150	150	150	150
Buterbaugh Brothers	GW	194	194	194	194
Carol Ann Fashions	GW	56	56	56	56
G&M Forest Products	GW	80	80	80	80
Howe's Leather(1)	SW	3,460	3,460	3,460	3,460
Howe's Leather(2)	SW	115,000	115,000	115,000	115,000
Kogen Industries Inc.	GW	100	100	100	100
Lee Brothers	SW	50	50	50	50
North American Refractories	SW	9,600	9,600	9,600	9,600
Quaker Sales Corp.	GW	4,000	4,000	4,000	4,000
R.L. Zimmerman	GW	3,080	3,080	3,080	3,080
T&T Machine	GW	45	45	45	45
Total		135,815	135,815	135,815	135,815

TABLE 19

NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 2
CONSUMPTIVE USE

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
AAA Capacitor	11	11	11	11
Buterbaugh Brothers	15	15	15	15
Carol Ann Fashions	4	4	4	4
G&M Forest Products	6	6	6	6
Howe's Leather(1)	216	216	216	216
Howe's Leather(2)	7,190	7,190	7,190	7,190
Kogen Industries Inc.	4	4	4	4
Lee Brothers	4	4	4	4
North American Refractories	1,260	1,260	1,260	1,260
Quaker Sales Corp.	608	608	608	608
R.L. Zimmerman	403	403	403	403
T&T Machine	2	2	2	2
Total	9,723	9,723	9,723	9,723

Water use estimates for self-supplied mineral industries in Section 2 are summarized in Tables 20 and 21. Total and consumptive uses are estimated to be 10.32 MGD and 1.81 MGD, respectively, and are projected to remain at these levels through 2010.

4. Agricultural Water Use

Total livestock and irrigation water use are estimated to be 0.13 MGD and 0.14 MGD, respectively. Livestock and irrigation consumption are estimated to be 0.10 MGD and 0.12 MGD.

5. Summary of Water Use in Subbasin Section 2

Tables 22 and 23 summarize estimates of water use in Section 2 through the year 2010. Mineral industries use and consume more water than any other use category considered in the section.

B. OCCURRENCE OF Q7-10 VALUE

Table 24 and Figures 7 and 8 summarize the occurrence of flows at or below the Q7-10 value in the West Branch Susquehanna River at Bower. Flows at or below the Q7-10 value have been documented in January, July, August, September, October, and November of various years. Flows of this magnitude occurred during more days in 1930 than in any other year of record.

TABLE 20

MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 2
TOTAL USE

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Bender Coal Co.(1)	GW	10,000	10,000	10,000	10,000
Bender Coal Co.(2)	GW	5,000	5,000	5,000	5,000
Bender Coal Co.(3)	GW	100,000	100,000	100,000	100,000
Bender Coal Co.(4)	GW	5,000	5,000	5,000	5,000
Benjamin Coal Co.(1)	GW	4,810	4,810	4,810	4,810
Benjamin Coal Co.(2)	GW	3,850	3,850	3,850	3,850
Deemer #1	GW	289	289	289	289
Dressler Coal	GW	2,890	2,890	2,890	2,890
Edmunds C&S	GW	3,920	3,920	3,920	3,920
Firebrick #1	GW	2,690	2,690	2,690	2,690
Gard Mining Inc.(1)	GW	4,760	4,760	4,760	4,760
Gard Mining Inc.(2)	GW	26,200	26,200	26,200	26,200
Greenwich Collieries(1)	SW	3,790	3,790	3,790	3,790
Greenwich Collieries(2)	GW	21,100	21,100	21,100	21,000
Greenwich Collieries(3)	GW	7,560,000	7,560,000	7,560,000	7,560,000
Hepburnia Coal Co.	GW	160	160	160	160
Hillsdale Mining	GW	65,200	65,200	65,200	65,200
Krtstianson & Johnson Coal(1)	SW	140,000	140,000	140,000	140,000
Krtstianson & Johnson Coal(2)	SW	1,460,000	1,460,000	1,460,000	1,460,000
K&J Coal Co.	GW	2,910	2,910	2,910	2,910
Lancashire Mine #25(1)	SW	32,200	32,200	32,200	32,200
Lancashire Mine #25(2)	GW	291,000	291,000	291,000	291,000
Lancashire #2	GW	290,000	290,000	290,000	290,000
L&J Energy Co.	GW	11,700	11,700	11,700	11,700
McDonald Land & Mining	GW	113	113	113	113
McDonald Land & Mining	GW	56	56	56	56
McDonald Land & Mining	GW	28	28	28	28
McDonald Land & Mining	GW	1,130	1,130	1,130	1,130
P&N Coal Co.	GW	28,800	28,800	28,800	28,800
Sky Haven Coal(1)	GW	2,880	2,880	2,880	2,880
Sky Haven Coal(2)	GW	115	115	115	115
Sky Haven Coal(3)	GW	115	115	115	115
Sky Haven Coal(4)	GW	2,880	2,880	2,880	2,880
Sky Haven Coal(5)	GW	2,880	2,880	2,880	2,880
Swistock Coal	GW	1,330	1,330	1,330	1,330
Thomas Coal Co.(1)	GW	450	450	450	450
Thomas Coal Co.(2)	GW	225	225	225	225
Thomas Coal Co.(3)	GW	506	506	506	506
Thomas Coal Co.(4)	GW	1,350	1,350	1,350	1,350
Thomas Coal Co.(5)	GW	675	675	675	675
Thomas Coal Co.(6)	GW	900	900	900	900
Thomas Coal Co.(7)	GW	225	225	225	225
Wescott Inc.	GW	228,000	228,000	228,000	228,000
Total		10,320,127	10,320,127	10,320,127	10,320,127

TABLE 21

MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 2
CONSUMPTIVE USE

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Bender Coal Co.(1)	1,790	1,790	1,790	1,790
Bender Coal Co.(2)	893	893	893	893
Bender Coal Co.(3)	17,900	17,900	17,900	17,900
Bender Coal Co.(4)	893	893	893	893
Benjamin Coal Co.(1)	859	859	859	859
Benjamin Coal Co.(2)	687	687	687	687
Deemer #1	34	34	34	34
Dressler Coal	516	516	516	516
Edmunds C&S	700	700	700	700
Firebrick #1	316	316	316	316
Gard Mining Inc.(1)	850	850	850	850
Gard Mining Inc.(2)	4680	4680	4680	4680
Greenwich Collieries(1)	677	677	677	677
Greenwich Collieries(2)	3,770	3,770	3,770	3,770
Greenwich Collieries(3)	1,350,000	1,350,000	1,350,000	1,350,000
Hepburnia Coal Co.	29	29	29	29
Hillsdale Mining	11,600	11,600	11,600	11,600
Krtstianson&Johnson Coal(1)	25,000	25,000	25,000	25,000
Krtstianson&Johnson Coal(2)	261,000	261,000	261,000	261,000
K&J Coal Co.	519	519	519	519
Lancashire Mine #25(1)	5,750	5,750	5,750	5,750
Lancashire Mine #25(2)	51,900	51,900	51,900	51,900
Lancashire #2	19,400	19,400	19,400	19,400
L&J Energy Co.	2,090	2,090	2,090	2,090
McDonald Land & Mining(1)	20	20	20	20
McDonald Land & Mining(2)	10	10	10	10
McDonald Land & Mining(3)	5	5	5	5
McDonald Land & Mining(4)	202	202	202	
P&N Coal Co.	5,140	5,140	5,140	5,140
Sky Haven Coal(1)	514	514	514	514
Sky Haven Coal(2)	21	21	21	21
Sky Haven Coal(3)	21	21	21	21
Sky Haven Coal(4)	514	514	514	514
Sky Haven Coal(5)	514	514	514	514
Swistock Coal	237	237	237	237
Thomas Coal Co.(1)	80	80	80	80
Thomas Coal Co.(2)	40	40	40	40
Thomas Coal Co.(3)	90	90	90	90
Thomas Coal Co.(4)	241	241	241	241
Thomas Coal Co.(5)	120	120	120	120
Thomas Coal Co.(6)	161	161	161	161
Thomas Coal Co.(7)	40	40	40	40
Wescott Inc.	40,700	40,700	40,700	40,700
Total	1,810,523	1,810,523	1,810,523	1,810,523

TABLE 22

TOTAL WATER USE SUMMARY FOR SECTION 2*

User	Total Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	4.25	4.12	4.03	4.02
Industrial				
Non-Mineral Self-Supplied	0.14	0.14	0.14	0.14
Mineral Self-Supplied	10.32	10.32	10.32	10.32
Agriculture				
Livestock	0.13	0.13	0.13	0.13
Irrigation	0.14	0.14	0.14	0.14
TOTAL	14.98	14.85	14.76	14.75
	(23.18 cfs)	(22.98 cfs)	(22.84 cfs)	(22.82 cfs)

* Assuming potential low flow conditions.

TABLE 23

CONSUMPTIVE WATER USE SUMMARY FOR SECTION 2*

User	Consumptive Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	0.85	0.82	0.81	0.80
Industrial				
Non-Mineral Self-Supplied	0.01	0.01	0.01	0.01
Mineral Self-Supplied	1.81	1.81	1.81	1.81
Agriculture				
Livestock	0.10	0.10	0.10	0.10
Irrigation	0.12	0.12	0.12	0.12
TOTAL	2.89	2.86	2.85	2.84
	(4.47 cfs)	(4.43 cfs)	(4.41 cfs)	(4.39 cfs)

* Assuming potential low flow conditions.

TABLE 24

FLOWS AT OR BELOW THE 7-DAY 10-YEAR LOW FLOW VALUE
FOR WEST BRANCH SUSQUEHANNA RIVER AT BOWER, PA.
(USGS SITE NO. 01541000)

Calendar Year	No. of Days Occurred	Months Occurred/ No. Days Per Month
1922	29	Sept./21, Oct./8
1929	1	Sept./1
1930	69	Aug./16, Sept./17, Oct./26 Nov./10
1931	8	Jan./8
1932	25	Sept./21, Oct./4
1933	4	Aug./4
1934	4	Jul./4
1936	3	Jul./3
1938	4	Oct./3, Nov./1
1939	44	Aug./9, Sept./21, Oct./14
1955	2	Sept./2
1957	1	Sept./1
TOTAL	194	Jan./8, Jul./7, Aug./29, Sept./84, Oct./55, Nov./11

FIGURE 7

NUMBER OF DAYS 7-DAY 10-YEAR LOW FLOW OCCURRED DURING PERIOD 1913 – 1986 WEST BRANCH SUSQUEHANNA RIVER @ BOWER

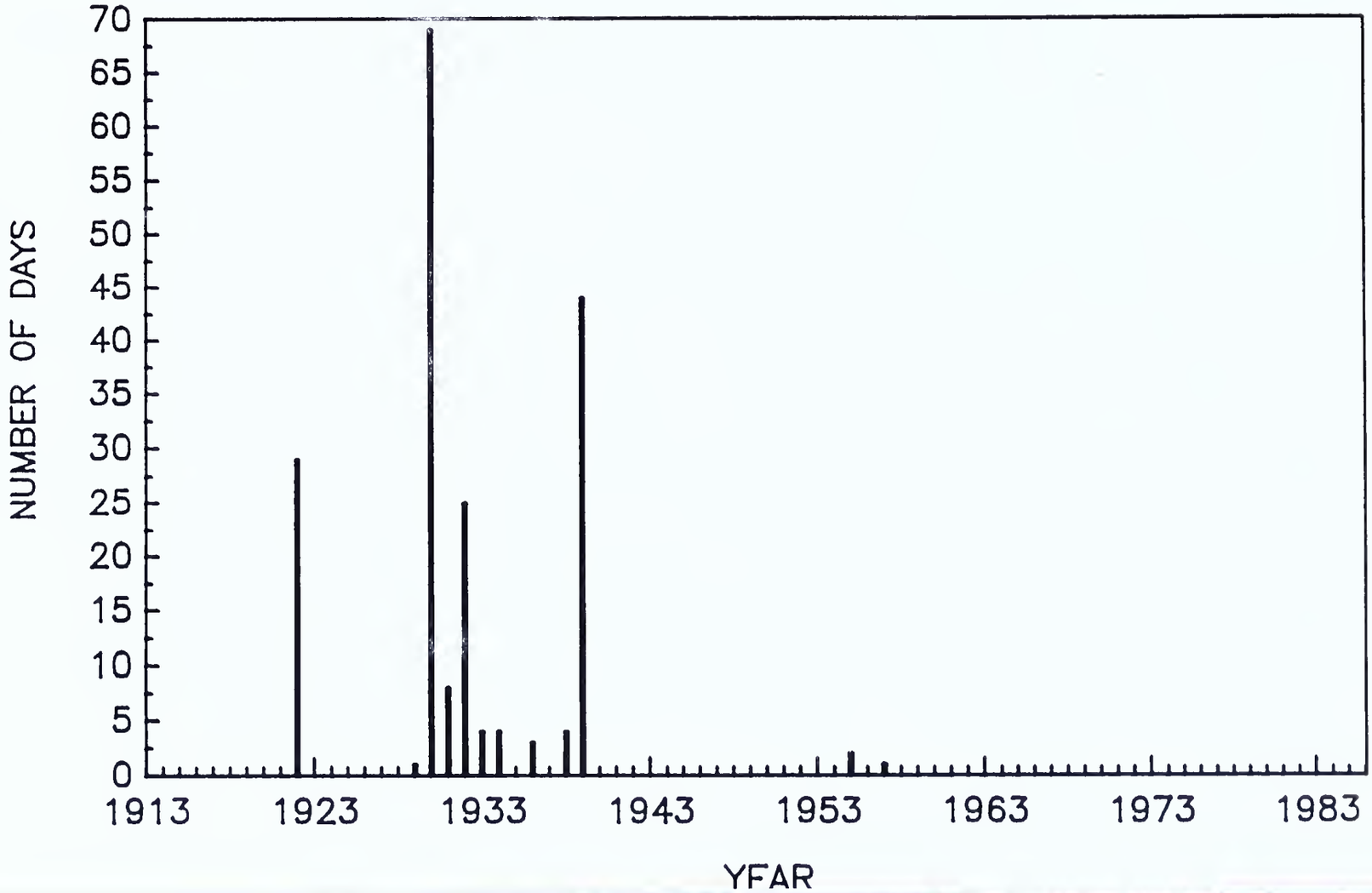
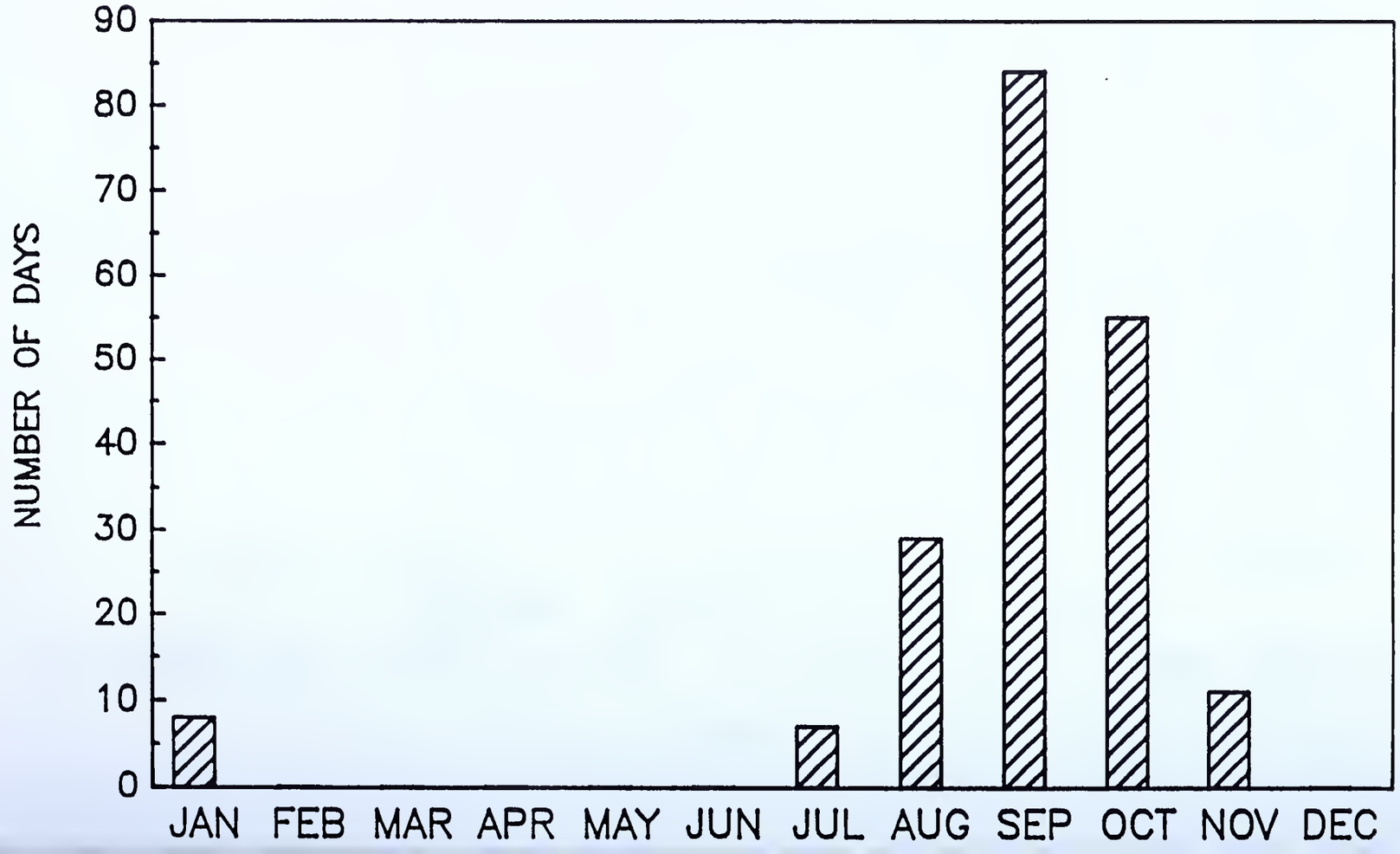


FIGURE 8

NUMBER OF DAYS 7-DAY 10-YEAR LOW FLOW OCCURRED
IN EACH MONTH
WEST BRANCH SUSQUEHANNA @ BOWER
(FOR PERIOD 1913 – 1986)



VI. SUBBASIN SECTION 3

CLEARFIELD CREEK AND WEST BRANCH SUSQUEHANNA RIVER FROM CLEARFIELD CREEK TO MOSHANNON CREEK

A. WATER USE

1. Municipal Water Use

Baseline water use data for the twelve public systems withdrawing water from Section 3 are summarized in Table 25. Water use projections for the section are summarized in Table 26. Total water use is expected to decrease from the baseline estimate of 0.68 MGD to 0.65 MGD by 2000, and then to increase to 0.66 MGD by 2010. Consumption is estimated to be 0.14 MGD under baseline conditions and 0.13 MGD in 2010.

2. Self-Supplied Non-Mineral Industrial Water Use

The largest water user in the entire West Branch Susquehanna River Subbasin is the Pennsylvania Electric Company's Shawville Power Plant. The plant's four operating units collectively use nearly all of the estimated 425.23 MGD withdrawn by self-supplied non-mineral industries in Section 3. However, only about 5.70 MGD of the total withdrawal is used consumptively . Water use by the Shawville Plant is expected to remain constant through 2010. Total use by other industries in Section 3 is expected to increase by about 0.01 MGD, with only very minor increases in consumptive use (Tables 27 and 28).

TABLE 25

BASELINE MUNICIPAL WATER USE DATA FOR SECTION 3
OF THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

Municipal System Name	Source	Pop. on System	Avg. Water Use (gpd)	GPCD	Peak Water Use (gpd)	Peak/Avg. Ratio
Blandburg Water Co.	SW	617	48,400	78.4	72,600	1.50
Coalport Boro Water Dept.	GW	802	36,140	45.1	54,210	1.50
Croft Water Supply	SW	106	6,000	56.4	10,500	1.75
Dean Twp. Water System	SW	149	9,990	67.2	14,985	1.50
G&H Water Co.	GW	155	42,000	270.9	63,000	1.50
Gallitzin Water Dept.	SW	3,058	190,220	62.1	211,144	1.11
Glendale Yearound Water Co.	GW	261	10,700	41.0	17,976	1.68
Glen Hope Water Assn.	GW,SW	163	9,050	55.5	9,503	1.05
Irvona Mun. Auth.	SW	1,450	143,900	99.3	178,436	1.24
Loretto Fed. Correctional Institution	GW	100	14,800	148.1	22,200	1.50
Prince Gallitzin State Park*	GW,SW		30,000		30,000	
Quehanna Covington	SW	891	140,790	157.9	211,185	1.50
TOTAL		7,752	681,990		895,739	

* No population, GPCD, water use projections, or peak value data available.

TABLE 26

MUNICIPAL WATER USE PROJECTIONS FOR SECTION 3

Parameter	Base	1990	2000	2010
Population Served	7,752	7,431	7,147	7,101
Avg. Daily Water Use (gpd)	681,990	665,410	654,850	657,110
Consumptive Use (gpd)	136,398	133,082	130,970	131,422
Peak Water Use (gpd)	895,739	878,561	869,385	875,235

TABLE 27

NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 3
TOTAL USE

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Shawville Units 1,2, 3,&4*	SW	425,200,000	425,200,000	425,200,000	425,200,000
K&F Wood Products	GW	2,670	2,670	2,670	2,670
Permagrain Products	SW	1,000	1,000	1,000	1,000
R&M Maines	GW	51	51	51	51
Vale Wood Dairy	GW	25,600	29,200	32,300	35,300
Total		425,229,321	425,232,921	425,236,021	425,239,021

* From Susquehanna River Basin Electric Utilities Group (1986).

TABLE 28

NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 3
CONSUMPTIVE USE

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Shawville Units 1,2,3,&4*	5,700,000	5,700,000	5,700,000	5,700,000
K&F Wood Products	206	206	206	206
Permagrain Products	77	77	77	77
R&M Maines	4	4	4	4
Vale Wood Dairy	1,830	2,090	2,310	2,520
Total	5,702,117	5,702,377	5,702,597	5,702,807

* From Susquehanna River Basin Electric Utilities Group (1986). Values cited in a 1987 update of this report were calculated using a methodology different from that used for the 1986 report. The 1986 values were larger and were considered by SRBC staff to be more representative of a worst case analysis. Installation of a wet cooling tower is presently being considered at this plant. Consumptive use would increase if the cooling tower is installed.

3. Self-Supplied Mineral Industrial Water Use

Mineral industries in Section 3 use a total of about 0.41 MGD of water and consume about 0.07 MGD. Use is projected to remain constant through the year 2010 (Tables 29 and 30).

4. Agricultural Water Use

Total livestock and irrigation water use are estimated to be 0.17 MGD and 0.16 MGD, respectively. Livestock and irrigation consumption are estimated to be 0.13 MGD and 0.14 MGD.

5. Summary of Water Use in Subbasin Section 3

Tables 31 and 32 summarize estimates of water use in Section 3 through the year 2010.

B. OCCURRENCE OF Q7-10 VALUE

Table 33 and Figures 9 and 10 summarize the occurrence of flows at or below the Q7-10 value in the West Branch Susquehanna River below Section 3 at Karthaus. Flows at or below the Q7-10 value have been documented in August, September, October, and November of various years. Flows of this magnitude occurred during more days in 1943 than in any other year of record.

TABLE 29

MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 3
TOTAL USE

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Ame Enterprises	GW	37,300	37,300	37,300	37,300
Bender Coal Co.(1)	GW	150,000	150,000	150,000	150,000
Bender Coal Co.(2)	GW	25,000	25,000	25,000	25,000
Cambria Coal Co.	SW	58,800	58,800	58,800	58,800
Cambria Mills Coal(1)	GW	2,080	2,080	2,080	2,080
Cambria Mills Coal(2)	GW	2,080	2,080	2,080	2,080
Carbon Mine Road	GW	2,000	2,000	2,000	2,000
Edmunds Contracting	GW	2,940	2,940	2,940	2,940
E. Hanslovan Coal Co.	GW	20,000	20,000	20,000	20,000
Flango Bros Coal	GW	2,880	2,880	2,880	2,880
Hartman Contractor	GW	2,080	2,080	2,080	2,080
Kerr Mine	GW	5,280	5,280	5,280	5,280
McDonald Land & Mining(1)	GW	563	563	563	563
McDonald Land & Mining(2)	GW	1,350	1,350	1,350	1,350
McDonald Land & Mining(3)	GW	338	338	338	338
Shale Hill Coal	GW	160	160	160	160
Sky Haven Coal(1)	GW	115	115	115	115
Sky Haven Coal(2)	GW	33,700	33,700	33,700	33,700
Sky Haven Coal(3)	GW	2,880	2,880	2,880	2,880
Sky Haven Coal(4)	GW	2,880	2,880	2,880	2,880
Sky Haven Coal(5)	GW	115	115	115	115
Sky Haven Coal(6)	GW	2,880	2,880	2,880	2,880
Sky Haven Coal(7)	GW	115	115	115	115
Sky Haven Coal(8)	GW	2,880	2,880	2,880	2,880
Sky Haven Coal(9)	GW	115	115	115	115
Sky Haven Coal(10)	GW	115	115	115	115
Sky Haven Coal(11)	GW	115	115	115	115
Sky Haven Coal(12)	GW	2,880	2,880	2,880	2,880
Sky Haven Coal(13)	GW	115	115	115	115
Sky Haven Coal(14)	GW	2,880	2,880	2,880	2,880
Sky Haven Coal(15)	GW	33,700	33,700	33,700	33,700
Sky Haven Coal(16)	GW	115	115	115	115
SRP Coal Co.(1)	GW	2,880	2,880	2,880	2,880
SRP Coal Co.(2)	GW	2,880	2,880	2,880	2,880
Swistock Coal	GW	2,600	2,600	2,600	2,600
Total		406,811	406,811	406,811	406,811

TABLE 30

MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 3
CONSUMPTIVE USE

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Ame Enterprises	6,660	6,660	6,660	6,660
Bender Coal Co.(1)	26,800	26,800	26,800	26,800
Bender Coal Co.(2)	4,460	4,460	4,460	4,460
Cambria Coal Co.	10,500	10,500	10,500	10,500
Cambria Mills Coal(1)	371	371	371	371
Cambria Mills Coal(2)	371	371	371	371
Carbon Mine Road	357	357	357	357
Edmunds Contracting	525	525	525	525
E. Hanslovan Coal Co.	3,570	3,570	3,570	3,570
Flango Bros Coal	514	514	514	514
Hartman Contractor	371	371	371	371
Kerr Mine	942	942	942	942
McDonald Land & Mining(1)	100	100	100	100
McDonald Land & Mining(2)	241	241	241	241
McDonald Land & Mining(3)	60	60	60	60
Shale Hill Coal	29	29	29	29
Sky Haven Coal(1)	21	21	21	21
Sky Haven Coal(2)	6,020	6,020	6,020	6,020
Sky Haven Coal(3)	514	514	514	514
Sky Haven Coal(4)	514	514	514	514
Sky Haven Coal(5)	21	21	21	21
Sky Haven Coal(6)	514	514	514	514
Sky Haven Coal(7)	21	21	21	21
Sky Haven Coal(8)	514	514	514	514
Sky Haven Coal(9)	21	21	21	21
Sky Haven Coal(10)	21	21	21	21
Sky Haven Coal(11)	21	21	21	21
Sky Haven Coal(12)	514	514	514	514
Sky Haven Coal(13)	21	21	21	21
Sky Haven Coal(14)	514	514	514	514
Sky Haven Coal(15)	6020	6020	6020	6020
Sky Haven Coal(16)	21	21	21	21
SRP Coal Co.(1)	514	514	514	514
SRP Coal Co.(2)	514	514	514	514
Swistock Coal	464	464	464	464
Total	72,655	72,655	72,655	72,655

TABLE 31

TOTAL WATER USE SUMMARY FOR SECTION 3*

User	Total Use (MGD) Base	1990	2000	2010
Municipal				
Domestic & Industry	0.68	0.67	0.65	0.66
Industrial				
Non-Mineral Self-Supplied	425.23	425.23	425.24	425.24
Mineral Self-Supplied	0.41	0.41	0.41	0.41
Agriculture				
Livestock	0.17	0.17	0.17	0.17
Irrigation	0.16	0.16	0.16	0.16
TOTAL	426.65 (660.17 cfs)	426.64 (660.16 cfs)	426.63 (660.14 cfs)	426.64 (660.16 cfs)

* Assuming potential low flow conditions.

TABLE 32

CONSUMPTIVE WATER USE SUMMARY FOR SECTION 3*

User	Consumptive Use (MGD) Base	1990	2000	2010
Municipal				
Domestic & Industry	0.14	0.13	0.13	0.13
Industrial				
Non-Mineral Self-Supplied	5.70	5.70	5.70	5.70
Mineral Self-Supplied	0.07	0.07	0.07	0.07
Agriculture				
Livestock	0.13	0.13	0.13	0.13
Irrigation	0.14	0.14	0.14	0.14
TOTAL	6.18 (9.56 cfs)	6.17 (9.55 cfs)	6.17 (9.55 cfs)	6.17 (9.55 cfs)

* Assuming potential low flow conditions.

TABLE 33

FLOWS AT OR BELOW THE 7-DAY 10-YEAR LOW FLOW VALUE
FOR WEST BRANCH SUSQUEHANNA RIVER AT KARTHAUS, PA.
(USGS SITE NO. 01542500)

Calendar Year	No. of Days Occurred	Months Occurred/ No. Days Per Month
1941	1	Sept./1
1943	32	Sept./17, Oct./15
1949	1	Aug./1
1955	10	Sept./10
1957	7	Sept./7
1959	3	Sept./3
1963	3	Oct./3
1964	15	Sept./11, Oct./2, Nov.2
TOTAL	72	Aug./1, Sept./49, Oct./20 Nov./2

FIGURE 9

NUMBER OF DAYS 7-DAY 10-YEAR LOW FLOW OCCURRED
DURING PERIOD 1939 – 1986
WEST BRANCH SUSQUEHANNA RIVER @ KARTHAUS

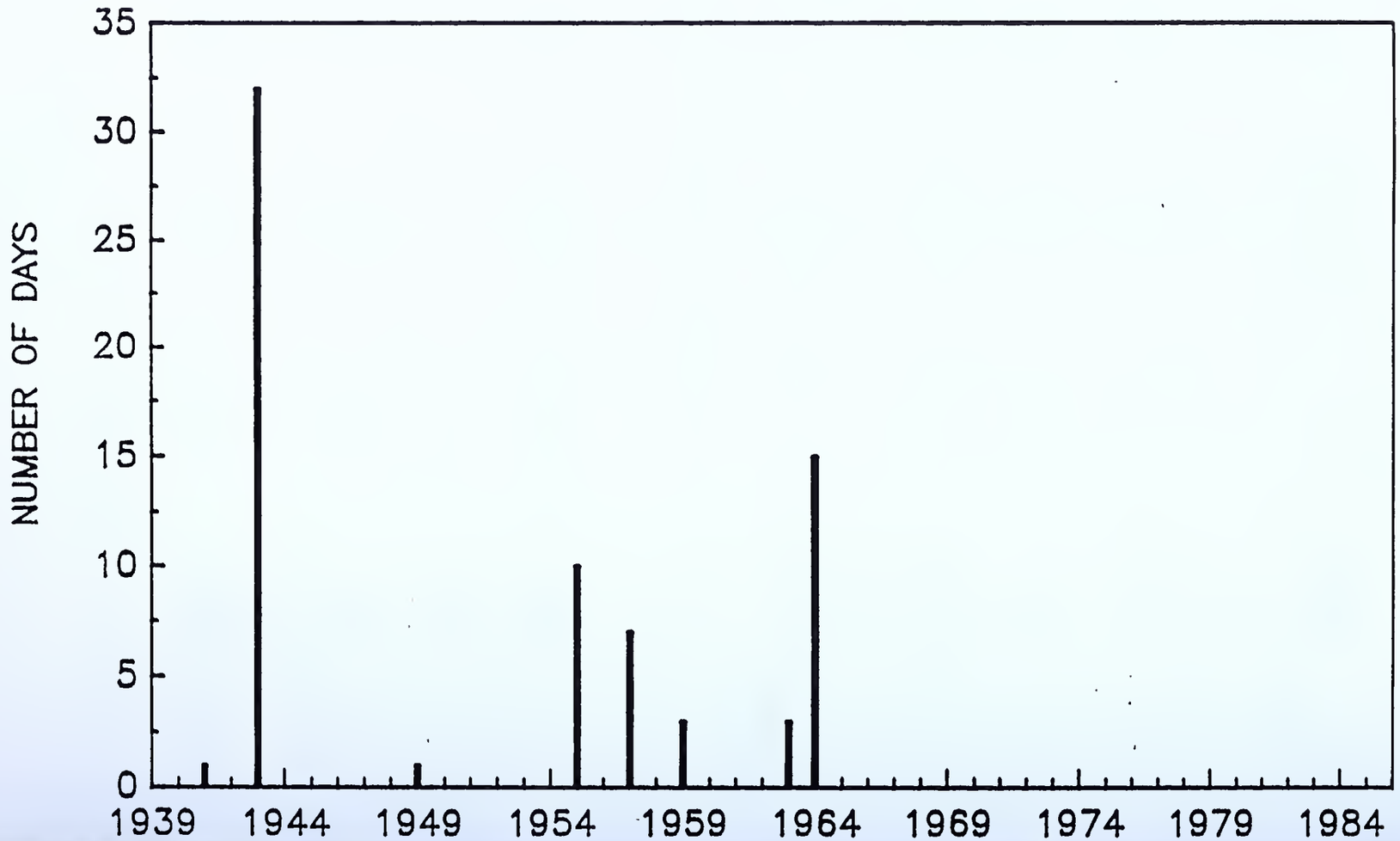
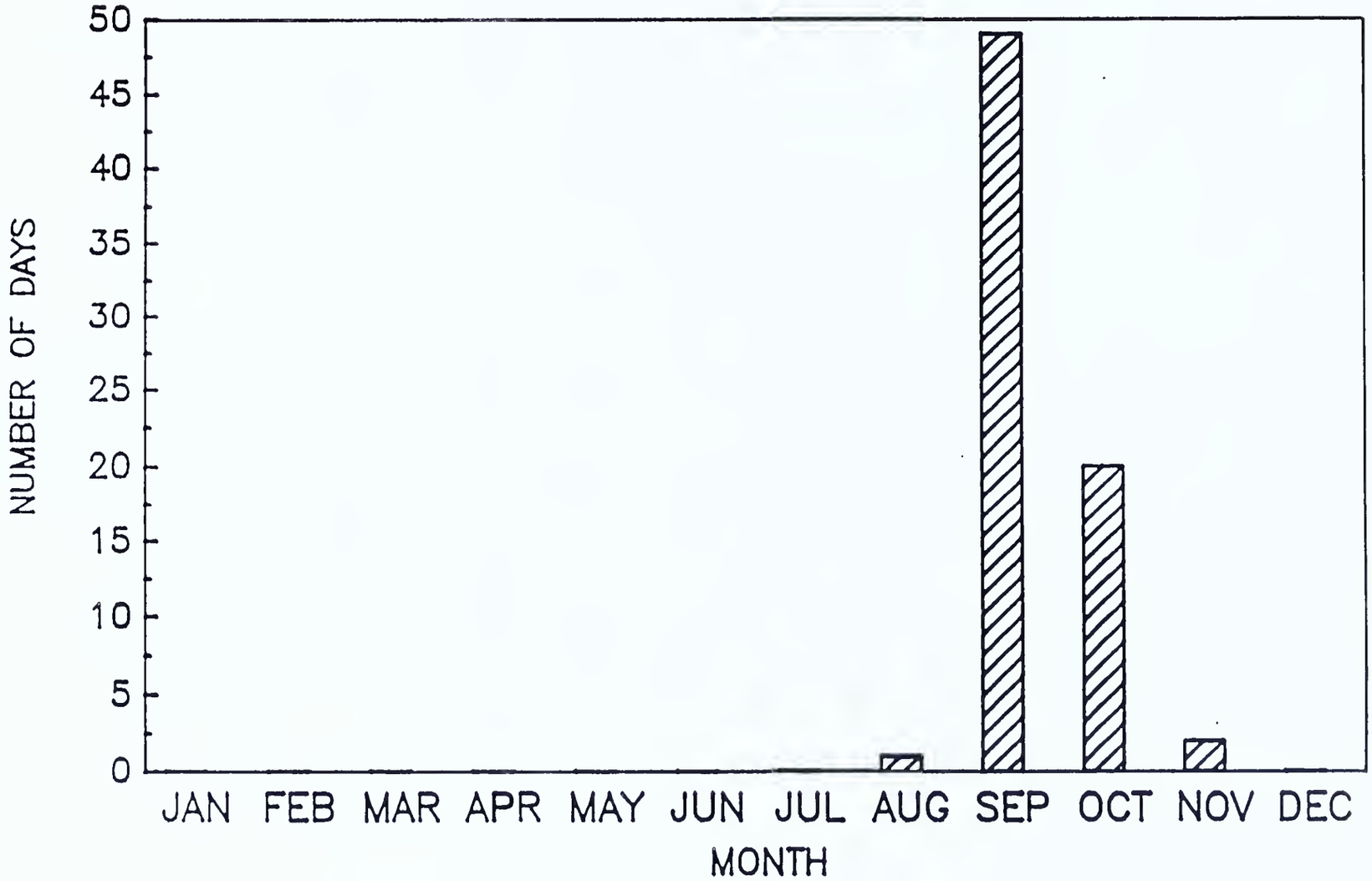


FIGURE 10

NUMBER OF DAYS 7-DAY 10-YEAR LOW FLOW OCCURRED
IN EACH MONTH
WEST BRANCH SUSQUEHANNA @ KARTHAUS
(FOR PERIOD 1939 – 1986)



VII. SUBBASIN SECTION 4

MOSHANNON CREEK AND WEST BRANCH SUSQUEHANNA RIVER FROM MOSHANNON CREEK TO SINNEMAHONING CREEK

A. WATER USE

1. Municipal Water Use

Baseline water use data for the seven public systems withdrawing water from Section 4 are summarized in Table 34. Water use projections for the section are summarized in Table 35. Total water use is expected to decrease slightly from the baseline estimate of 2.37 MGD, and then to increase to 2.47 MGD by 2010. Consumption is estimated to be 0.47 MGD under baseline conditions and 0.49 MGD in 2010.

2. Self-Supplied Non-Mineral Industrial Water Use

The only non-mineral industrial water withdrawal reported in Section 4 is made by the Piper Aircraft Corporation Plant located northwest of Karthaus. The baseline total water withdrawal is about 20,800 gpd (0.02 MGD), with about 1,330 gpd (less than 0.01 MGD) consumed. No increase in use is projected through 2010.

3. Self-Supplied Mineral Industrial Water Use

Mineral industries in Section 4 use a total of about 5.17 MGD and consume about 0.92 MGD. Use is projected to remain constant through 2010 (Tables 36 and 37).

TABLE 34

BASELINE MUNICIPAL WATER USE DATA FOR SECTION 4
OF THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

Municipal System Name	Source	Pop. on System	Avg. Water Use (gpd)	GPCD	Peak Water Use (gpd)	Peak/Avg. Ratio
Black Moshannon State Park*	GW		8,480		8,480	
Cooper Twp. Mun. Authority	SW	2,098	246,950	117.4	321,035	1.30
Houtzdale Mun. Authority	GW,SW	6,450	700,600	108.5	798,684	1.14
Pa. American Water Co.- Moshannon Valley	SW	9,346	1,329,940	145.9	1,702,323	1.28
Sandy Ridge Water Authority	GW	528	30,200	57.2	45,300	1.50
Wallacetown Mun. Authority	SW	387	20,047	51.6	23,054	1.15
W. Decatur Authority	GW	654	38,000	58.1	57,000	1.50
TOTAL		19,463	2,374,217		2,955,876	

* No population, GPCD, water use projections, or peak value data available.

TABLE 35

MUNICIPAL WATER USE PROJECTIONS FOR SECTION 4

Parameter	Base	1990	2000	2010
Population Served	19,463	19,424	20,205	20,465
Avg. Daily Water Use (gpd)	2,374,217	2,350,152	2,440,683	2,469,490
Consumptive Use (gpd)	474,843	470,030	488,137	493,898
Peak Water Use (gpd)	2,955,876	2,924,856	3,040,088	3,078,607

TABLE 36
MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 4
TOTAL USE

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
AME Enterprises(1)	GW	4,710	4,710	4,710	4,710
AME Enterprises(2)	GW	16,500	16,500	16,500	16,500
AME Enterprises(3)	GW	12,700	12,700	12,700	12,700
AME Enterprises(4)	GW	26,200	26,200	26,200	26,200
AME Enterprises(5)	GW	48,100	48,100	48,100	48,100
Ashcroft Coal Co.	GW	6,670	6,670	6,670	6,670
Cambria Mills Coal	GW	2,880	2,880	2,880	2,880
Cowfer Contracting(1)	GW	2,080	2,080	2,080	2,080
Cowfer Contracting(2)	GW	2,080	2,080	2,080	2,080
Cowfer Contracting(3)	GW	2,080	2,080	2,080	2,080
Jill Mining Co.	GW	192	192	192	192
Kasubick #4	GW	2,400	2,400	2,400	2,400
Power Constructing Co.	GW	2,000	2,000	2,000	2,000
River Hill Coal(1)	GW	15,700	15,700	15,700	15,700
River Hill Coal(2)	SW	2,860	2,860	2,860	2,860
River Hill Coal(3)	GW	5,230	5,230	5,230	5,230
Rushton Mining Co.	GW	5,010,000	5,010,000	5,010,000	5,010,000
Sky Haven Coal(1)	GW	2,880	2,880	2,880	2,880
Sky Haven Coal(2)	GW	115	115	115	115
Total		5,165,377	5,165,377	5,165,377	5,165,377

TABLE 37

MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 4
CONSUMPTIVE USE

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
AME Enterprises(1)	841	841	841	841
AME Enterprises(2)	2,950	2,950	2,950	2,950
AME Enterprises(3)	2,270	2,270	2,270	2,270
AME Enterprises(4)	4,680	4,680	4,680	4,680
AME Enterprises(5)	8,590	8,590	8,590	8,590
Ashcroft Coal Co.	1,190	1,190	1,190	1,190
Cambria Mills Coal	514	514	514	514
Cowfer Contracting(1)	371	371	371	371
Cowfer Contracting(2)	371	371	371	371
Cowfer Contracting(3)	371	371	371	371

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Jill Mining Co.	34	34	34	34
Kasubick #4	428	428	428	428
Power Contructing Co.	357	357	357	357
River Hill Coal(1)	2,800	2,800	2,800	2,800
River Hill Coal(2)	511	511	511	511
River Hill Coal(3)	934	934	934	934
Rushton Mining Co.	894,000	894,000	894,000	894,000
Sky Haven Coal(1)	514	514	514	514
Sky Haven Coal(2)	21	21	21	21
Total	921,747	921,747	921,747	921,747

4. Agricultural Water Use

Total livestock and irrigation water use are estimated to be 0.18 MGD and 0.20 MGD, respectively. Livestock and irrigation consumption are estimated to be 0.14 MGD and 0.17 MGD.

5. Summary of Water Use in Subbasin Section 4

Tables 38 and 39 summarize estimates of water use in Section 4 through the year 2010.

B. OCCURRENCE OF Q7-10 VALUE

Occurrence of flows at or below the Q7-10 value in the West Branch Susquehanna River at Karthaus was summarized previously in Table 33, page 72, and Figures 9 and 10, pages 73 and 74.

TABLE 38

TOTAL WATER USE SUMMARY FOR SECTION 4*

User	Total Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	2.37	2.35	2.44	2.47
Industrial				
Non-Mineral Self-Supplied	0.02	0.02	0.02	0.02
Mineral Self-Supplied	5.17	5.17	5.17	5.17
Agriculture				
Livestock	0.18	0.18	0.18	0.18
Irrigation	0.20	0.20	0.20	0.20
TOTAL	7.94 (12.29 cfs)	7.92 (12.25 cfs)	8.01 (12.39 cfs)	8.04 (12.44 cfs)

* Assuming potential low flow conditions.

TABLE 39

CONSUMPTIVE WATER USE SUMMARY FOR SECTION 4*

User	Consumptive Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	0.47	0.47	0.49	0.49
Industrial				
Non-Mineral Self-Supplied	<0.01	<0.01	<0.01	<0.01
Mineral Self-Supplied	0.92	0.92	0.92	0.92
Agriculture				
Livestock	0.14	0.14	0.14	0.14
Irrigation	0.17	0.17	0.17	0.17
TOTAL	1.70 (2.63 cfs)	1.70 (2.63 cfs)	1.72 (2.66 cfs)	1.72 (2.66 cfs)

* Assuming potential low flow conditions.

VII. SUBBASIN SECTION 5

BALD EAGLE CREEK

A. WATER USE

1. Municipal Water Use

Public water supply systems use more water in Section 5 than in any other section of the West Branch Susquehanna River Subbasin. Baseline water use data for the thirty public systems withdrawing water from Section 5 are summarized in Table 40. Water use projections for the section are summarized in Table 41. Total water use is expected to increase from the baseline estimate of 16.21 MGD to 17.89 MGD in 2010. Consumption is estimated to be 3.24 MGD under baseline conditions and 3.58 MGD in 2010.

2. Self-Supplied Non-Mineral Industrial Water Use

Total water use by non-mineral industries in Section 5 is expected to increase from about 3.59 MGD under baseline conditions to about 3.61 MGD in 2010 (Table 42). Consumption is estimated to be 0.44 MGD for the base year and is expected to increase by less than 0.01 MGD by 2010 (Table 43).

3. Self-Supplied Mineral Industrial Water Use

Both limestone and coal are mined in Section 5. Mineral industries have a baseline combined total withdrawal of about 5.52 MGD and consume about 0.38 MGD. Water use and consumption are projected to remain constant through 2010 (Tables 44 and 45).

TABLE 40

BASELINE MUNICIPAL WATER USE DATA FOR SECTION 5
OF THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

Municipal System Name	Source	Pop. on System	Avg. Water Use (gpd)	GPCD	Peak Water Use (gpd)	Peak/Avg. Ratio
Bald Eagle State Park*	GW		7,290		7,290	
Beech Creek Boro Authority	GW,SW	1,907	199,680	104.9	365,414	1.83
Bellefonte Boro Water Dept.	SW	8,030	5,313,000	661.3	7,916,370	1.49
Boggs Twp. Authority	GW	22	44,500	1982.5	66,750	1.50
Eastville Water Association	GW	58	3,000	51.7	4,500	1.50
Ferguson Twp. Authority	GW,SW	1,165	65,000	55.8	118,950	1.83
Harris Twp. Water System	GW,SW	3,208	305,600	95.1	458,400	1.50
Holters Crossing Water Authority	SW	188	12,000	63.8	18,000	1.50
Howard Water Department	GW,SW	996	51,960	52.2	77,940	1.50
Lemont Water Co.	GW	4,679	572,000	122.2	858,000	1.50
Loganton Boro Water Co.	SW	474	68,400	144.3	106,704	1.56
Mackeyville Water Co.	SW	324	38,000	117.3	57,000	1.50
Milesburg Boro Authority	SW	1,682	285,400	169.5	428,100	1.50
Monument Water Association	SW	153	7,500	49.0	11,250	1.50

* No population, GPCD, water use projections, or peak value data available.

Municipal System Name	Source	Pop. on System	Avg. Water Use (gpd)	GPCD	Peak Water Use (gpd)	Peak/Avg. Ratio
Mt. Eagle Water Assn.	SW	125	8,000	64.0	12,000	1.50
Nittany Water Co.	SW	1,524	60,000	39.4	90,000	1.50
Oak Hall Water System	SW	125	11,000	88.2	18,700	1.70
Orviston Water Association	SW	193	17,000	88.1	25,500	1.50
Penn State University	GW	12,537	3,600,000	287.4	5,040,000	1.40
Port Matilda Waterworks	GW,SW	668	49,970	74.8	74,955	1.50
Ridgemont Water Assn, Inc.	GW	54	4,400	81.4	6,292	1.43
Rockview State Correctional Institution	SW	797	450,000	564.8	598,500	1.33
Rote Mutual Water Co.	SW	639	123,000	192.5	150,060	1.22
64 Water Co., Inc.	SW	313	54,040	172.5	54,040	1.00
Snow Shoe Boro Auth.	SW	921	121,030	131.0	142,815	1.18
Spring Twp. Mun. Auth.	GW,SW	2,230	270,100	121.1	270,100	1.00
State College Water Auth.	GW,SW	32,194	3,944,600	122.7	5,127,980	1.30
Tylersville Mutual Water Association	SW	202	11,200	55.4	16,800	1.50
Unionville Water Auth.	SW	361	24,700	68.4	26,923	1.09

Municipal System Name	Source	Pop. on System	Avg. Water Use (gpd)	GPCD	Peak Water Use (gpd)	Peak/Avg. Ratio
Walker Twp. Water Assn.	GW,SW	2,218	487,000	219.6	905,820	1.86
TOTAL		77,987	16,209,370		23,055,153	

TABLE 41

MUNICIPAL WATER USE PROJECTIONS FOR SECTION 5

Parameter	Base	1990	2000	2010
Population Served	77,987	82,190	87,510	90,733
Avg. Daily Water Use (gpd)	16,209,370	16,627,690	17,413,510	17,888,550
Consumptive Use (gpd)	3,241,874	3,325,538	3,482,702	3,577,710
Peak Water Use (gpd)	23,055,153	23,667,499	24,812,028	25,520,821

TABLE 42

NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 5
TOTAL USE

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Agway Inc.(1)	GW	39	39	39	39
Agway Inc.(2)	GW	39	39	39	39
Bowman Asphalt Inc.	GW	59	59	59	59
Brown Junior Motors	GW	76	76	76	76
C-Cor Electronics Inc.	GW	1,080	1,080	1,080	1,080
Cerro Metal Products	GW	393,000	393,000	393,000	393,000
Con-Lime	GW	11,000	11,000	11,000	11,000
Glossners Concrete(1)	GW	108	108	108	108
Glossners Concrete(2)	SW	750	750	750	750
Grove Printing	GW	115	137	158	178
H E Eby Paving	GW	30	30	30	30
Hammermill Paper Co.	SW	27,900	31,200	36,800	42,400
Himes Printing Co. Inc	GW	3,330	3,960	4,560	5,160
I A Construction	SW	1,000	1,000	1,000	1,000
Imbt Inc Herbert R	GW	400	400	400	400
Island Poultry Farm	GW	2,310	2,630	2,910	3,190
Leco Corporation	GW	525	656	803	950
Lynn D Wert	GW	60	60	60	60
Marblehead Lime Co.(1)	GW	4,320	4,320	4,320	4,320
Marblehead Lime Co.(2)	GW	3,120,000	3,120,000	3,120,000	3,120,000
Nittany Printing & Publish	GW	2,570	3,060	3,520	3,980
State of the Art	GW	5,040	5,040	5,040	5,040
Supelco Inc	GW	6,730	6,730	6,730	6,730
Ruetgers-Nease Chem	GW	5,050	5,050	5,050	5,050
Woolrich Woolen Mills	SW	2,440	2,440	2,440	2,440
Total		3,587,971	3,592,864	3,599,972	3,607,079

TABLE 43

NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 5
CONSUMPTIVE USE

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Agway Inc.(1)	3	3	3	3
Agway Inc.(2)	3	3	3	3
Bowman Asphalt Inc.	9	9	9	9
Brown Junior Motors	5	5	5	5
C-Cor Electronics Inc.	77	77	77	77
Cerro Metal Products	24,200	24,200	24,200	24,200
Con-Lime	1,440	1,440	1,440	1,440
Glossners Concrete(1)	14	14	14	14
Glossners Concrete(2)	98	98	98	98
Grove Printing	9	11	12	14
H E Eby Paving	5	5	5	5
Hammermill Paper Co.	2,160	2,410	2,840	3,280
Himes Printing Co. Inc	256	305	351	397
I A Construction	152	152	152	152
Imbt Inc Herbert R	61	61	61	61
Island Poultry Farm	165	188	208	228
Leco Corporation	28	35	42	50
Lynn D Wert	5	5	5	5
Marblehead Lime Co.(1)	566	566	566	566
Marblehead Lime Co.(2)	409,000	409,000	409,000	409,000
Nittany Printing & Publish	198	236	271	306
State of the Art	360	360	360	360
Supelco Inc	452	452	452	452
Ruetgers-Nease Chem	339	339	339	339
Woolrich Woolen Mills	188	188	188	188
Total	439,793	440,162	440,701	441,252

TABLE 44

MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 5
TOTAL USE

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Bellefonte Lime Co.	GW	767,000	767,000	767,000	767,000
Black Hawk Quarry	GW	320	320	320	320
Central Valley Aggreg	GW	8,670	8,670	8,670	8,670
Coal Strip Mine #1	GW	40,000	40,000	40,000	40,000
Coal Strip Mine #2	GW	40,000	40,000	40,000	40,000
ConLime Inc	GW	1,100,000	1,100,000	1,100,000	1,100,000
Herbert R Imbt Co.(1)	GW	15,300	15,300	15,300	15,300
Herbert R Imbt Co.(2)	GW	7,640	7,640	7,640	7,640
Herbert R Imbt Co.(3)	GW	32,500	32,500	32,500	32,500
Herbert R Imbt Co.(4)	SW	6,060	6,060	6,060	6,060
Herbert R Imbt Co.(5)	GW	364,000	364,000	364,000	364,000
Herbert R Imbt Co.(6)	GW	6,060	6,060	6,060	6,060
Marblehead Lime Co.(1)	GW	4,330	4,330	4,330	4,330
Marblehead Lime Co.(2)	GW	3,130,000	3,130,000	3,130,000	3,130,000
Total		5,521,880	5,521,880	5,521,880	5,521,880

TABLE 45

MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 5
CONSUMPTIVE USE

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Bellefonte Lime Co.	51,400	51,400	51,400	51,400
Black Hawk Quarry	21	21	21	21
Central Valley Aggreg	581	581	581	581
Coal Strip Mine #1	7,140	7,140	7,140	7,140
Coal Strip Mine #2	7,140	7,140	7,140	7,140
ConLime Inc	73,700	73,700	73,700	73,700
Herbert R Imbt Co.(1)	1,030	1,030	1,030	1,030
Herbert R Imbt Co.(2)	512	512	512	512
Herbert R Imbt Co.(3)	2,180	2,180	2,180	2,180
Herbert R Imbt Co.(4)	406	406	406	406
Herbert R Imbt Co.(5)	24,400	24,400	24,400	24,400
Herbert R Imbt Co.(6)	406	406	406	406
Marblehead Lime Co.(1)	290	290	290	290
Marblehead Lime Co.(2)	210,000	210,000	210,000	210,000
Total	379,206	379,206	379,206	379,206

4. Agricultural Water Use

Total livestock and irrigation water use are estimated to be 0.31 MGD and 0.49 MGD, respectively. Livestock and irrigation consumption are estimated to be 0.23 MGD and 0.42 MGD.

5. Summary of Water Use in Subbasin Section 5

Tables 46 and 47 summarize estimates of water use in Section 5 through the year 2010.

B. OCCURRENCE OF Q7-10 VALUE

Table 48 and Figures 11 and 12 summarize the occurrence of flows at or below the Q7-10 value in Bald Eagle Creek at Beech Creek Station. Flows at or below the Q7-10 value have been documented in January, February, July, August, September, October, November, and December of various years. Flows of this magnitude occurred during more days in 1930 than in any other year of record.

TABLE 46

TOTAL WATER USE SUMMARY FOR SECTION 5*

User	Total Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	16.21	16.63	17.41	17.89
Industrial				
Non-Mineral Self-Supplied	3.59	3.59	3.60	3.61
Mineral Self-Supplied	5.52	5.52	5.52	5.52
Agriculture				
Livestock	0.31	0.31	0.31	0.31
Irrigation	0.49	0.49	0.49	0.49
TOTAL	26.12	26.54	27.33	27.82
	(40.42 cfs)	(41.07 cfs)	(42.29 cfs)	(43.05 cfs)

* Assuming potential low flow conditions.

TABLE 47

CONSUMPTIVE WATER USE SUMMARY FOR SECTION 5*

User	Consumptive Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	3.24	3.33	3.48	3.58
Industrial				
Non-Mineral Self-Supplied	0.44	0.44	0.44	0.44
Mineral Self-Supplied	0.38	0.38	0.38	0.38
Agriculture				
Livestock	0.23	0.23	0.23	0.23
Irrigation	0.42	0.42	0.42	0.42
TOTAL	4.71	4.80	4.95	5.05
	(7.29 cfs)	(7.43 cfs)	(7.66 cfs)	(7.81 cfs)

* Assuming potential low flow conditions.

TABLE 48

FLOWS AT OR BELOW THE 7-DAY 10-YEAR LOW FLOW VALUE
FOR BALD EAGLE CREEK AT BEECH CREEK STATION, PA.
(USGS SITE NO. 01548000)

Calendar Year	No. of Days Occurred	Months Occurred/ No. Days Per Month
1925	8	Sept./8
1926	2	Aug./2
1930	75	Aug./1, Sept./1, Oct./24, Nov./28, Dec./21
1931	34	Jan./24, Feb./10
1932	22	Sept./18, Oct.4
1938	4	Oct./4
1940	1	Oct./1
1941	2	Sept./1, Oct./1
1963	3	Sept./2, Oct./1
1964	36	Sept./12, Oct./7, Nov./11, Dec./6
1965	17	Jul./5, Sept./11, Oct./1
1966	12	Aug./9, Sept./3
TOTAL	216	Jan./24, Feb./10, Jul./5 Aug./12, Sept./56, Oct./43 Nov./39, Dec./27

FIGURE 11

NUMBER OF DAYS 7-DAY 10-YEAR LOW FLOW OCCURRED DURING PERIOD 1910 – 1985 BALD EAGLE CREEK @ BEECH CREEK STATION

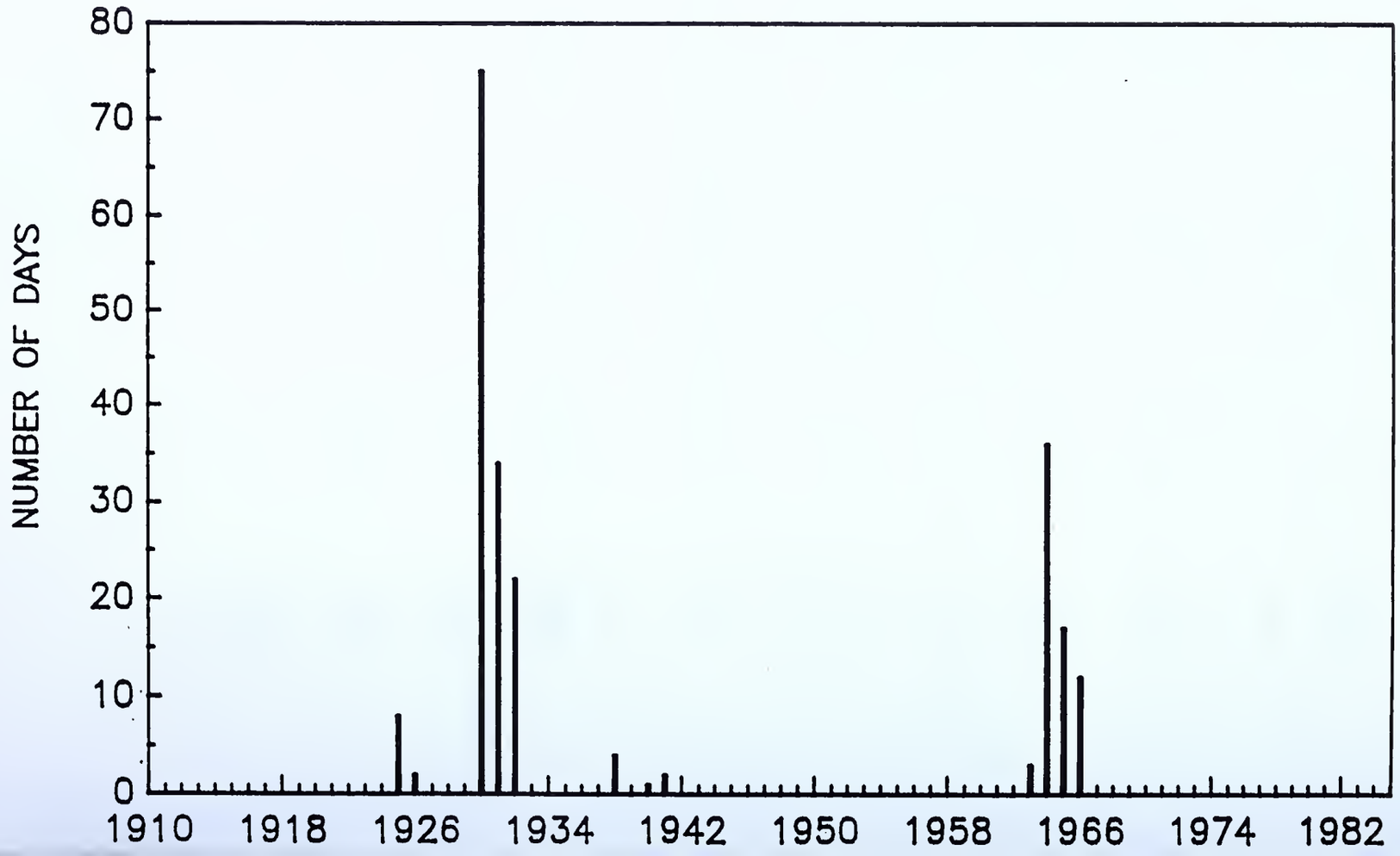
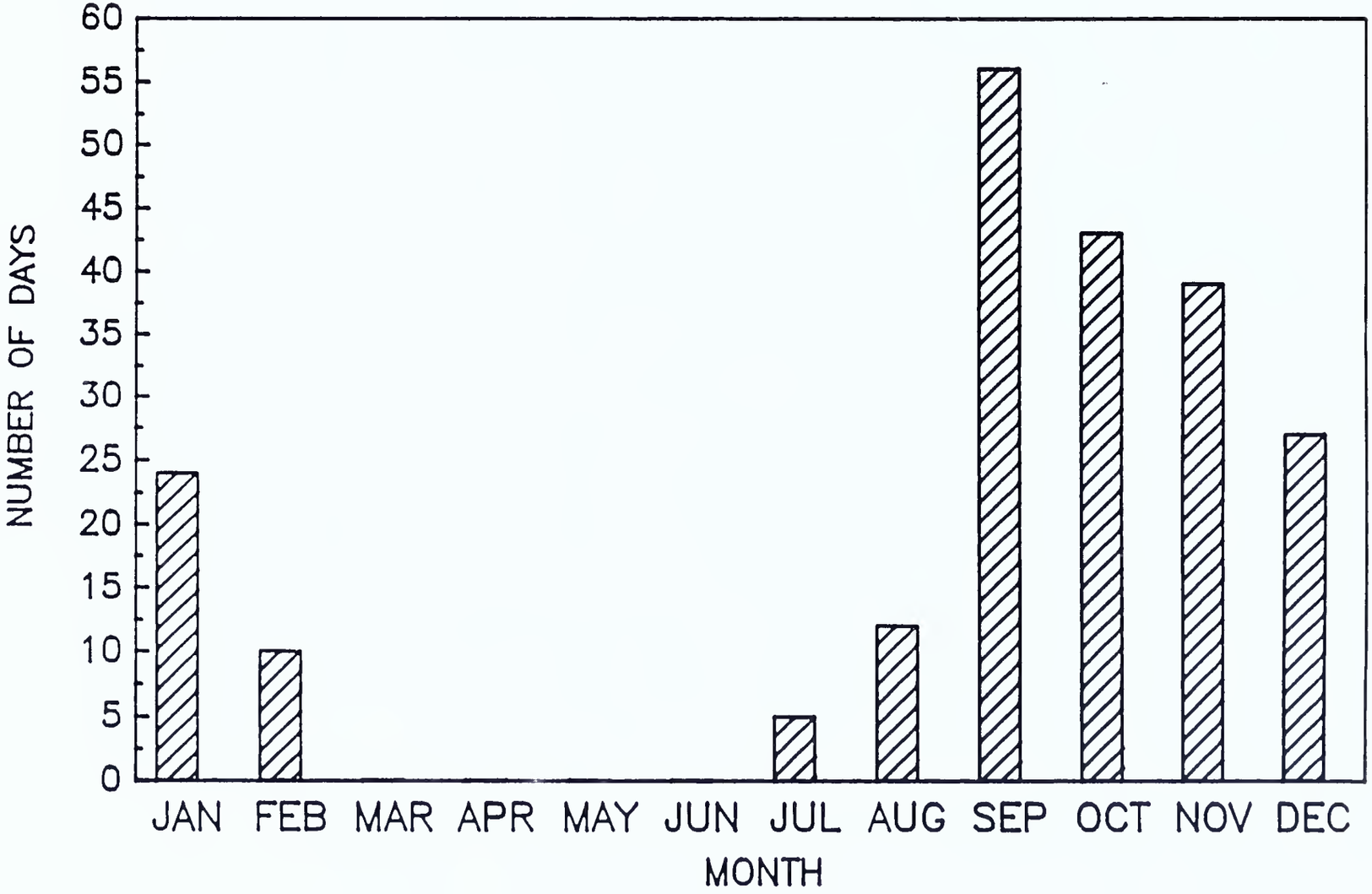


FIGURE 12

NUMBER OF DAYS 7-DAY 10-YEAR LOW FLOW OCCURRED
IN EACH MONTH
BALD EAGLE CREEK @ BEECH CREEK STATION
(FOR PERIOD 1910 – 1985)



IX. SUBBASIN SECTION 6

WEST BRANCH SUSQUEHANNA RIVER FROM MOUTH OF SINNEMAHONING CREEK TO AND INCLUDING PINE CREEK

A. WATER USE

1. Municipal Water Use

Baseline water use data for the eleven public systems withdrawing water from Section 6 are summarized in Table 49. Water use projections are summarized in Table 50. Total water use is expected to decrease from the baseline estimate of 6.46 MGD to 6.33 MGD by 2000, and then to increase to 6.40 MGD by 2010. Consumption is estimated to be 1.29 MGD under baseline conditions and 1.28 MGD in 2010.

2. Self-Supplied Non-Mineral Industrial Water Use

Total and consumptive water use data for non-mineral industries in Section 6 are summarized in Tables 51 and 52. Baseline total and consumptive uses are about 0.82 MGD and 0.05 MGD, respectively. Only minor increases in total use (less than 0.01 MGD) are projected through the year 2010.

3. Self-Supplied Mineral Industrial Water Use

Water use data for self-supplied mineral industries in Section 6 are summarized in Tables 53 and 54. Total estimated baseline use is 0.57 MGD, while consumption is 0.10 MGD. No significant increases are projected through the year 2010.

TABLE 49

BASELINE MUNICIPAL WATER USE DATA FOR SECTION 6
OF THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

Municipal System Name	Source	Pop. on System	Avg. Water Use (gpd)	GPCD	Peak Water Use (gpd)	Peak/Avg. Ratio
Chatham Water Co.	GW,SW	4,143	1,200,500	286.9	1,800,750	1.50
Farwell Community Water Association	GW	341	29,000	85.0	43,500	1.50
Galeton Boro Authority	GW,SW	1,550	225,800	145.8	399,666	1.77
Jersey Shore Area Jt. Water Auth.	GW,SW	6,741	1,330,100	197.3	1,995,150	1.50
Lock Haven City Auth. McElhattan System*	GW,SW	7,914	1,450,460	183.9	2,175,690	1.50
Renovo Boro Water Dept.	SW	1,886	60,890	32.3	91,335	1.50
S. Renovo Boro Water Dept.	SW	803	149,000	185.6	263,730	1.77
Suburban Lock Haven Water Auth.*	GW,SW	8,369	826,500	98.8	942,210	1.14
Waterville Water Assn.	SW	96	6,000	62.5	9,000	1.50
Watrous Water Assn. Inc.	SW	63	6,450	102.9	9,675	1.50
Wellsboro Water Dept.	GW,SW	4,038	1,179,200	292.2	1,768,800	1.50
TOTAL		35,944	6,463,900		9,499,506	

* Have sources in both Sections 5 & 6, but primary sources are in Section 6.

TABLE 50

MUNICIPAL WATER USE PROJECTIONS FOR SECTION 6

Parameter	Base	1990	2000	2010
Population Served	35,944	35,306	35,463	35,941
Avg. Daily Water Use (gpd)	6,463,900	6,335,500	6,329,060	6,397,970
Consumptive Use (gpd)	1,292,780	1,267,100	1,265,812	1,279,594
Peak Water Use (gpd)	9,499,506	9,293,280	9,270,453	9,363,990

TABLE 51
NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 6
TOTAL USE

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Borden, Inc.	GW	5,770	6,580	7,270	7,960
Daniel Fisher	GW	6	7	8	8
Dresser Mfg Div	GW	16,000	16,000	16,000	16,000
Foremost Agricultural	GW	77	77	77	77
Gaines Co	GW	239	239	239	239
GTE Products Corp	GW	35,200	35,200	35,200	35,200
Jersey Shore Steel	GW	753,000	753,000	753,000	753,000
Joe Swope's Sawmill	GW	5	5	5	5
Mitstifer Bros	GW	175	175	175	175
Shablonski Cement	SW	357	357	357	357
Shumway's Meat	GW	900	1,030	1,130	1,240
St Marys Carbon Co. Inc.	GW	3,100	3,100	3,100	3,100
Wheeland Lumber Co.	GW	1	1	1	1
Woolrich Woolen Mills	SW	612	612	612	612
Wundies Inc	GW	1,720	1,720	1,720	1,720
Total		817,162	818,103	818,894	819,694

TABLE 52
NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 6
CONSUMPTIVE USE

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Borden, Inc.	413	470	520	569
Daniel Fisher	0	1	1	1
Dresser Mfg Div	706	706	706	706
Foremost Agricultural	5	5	5	5
Gaines Co	17	17	17	17
GTE Products Corp	4,610	4,610	4,610	4,610
Jersey Shore Steel	46,500	46,500	46,500	46,500
Joe Swope's Sawmill	0	0	0	0
Mitstifer Bros	13	13	13	13
Shablonski Cement	47	47	47	47
Shumway's Meat	64	74	81	89
St Marys Carbon Co. Inc.	191	191	191	191
Wheeland Lumber Co.	0	0	0	0
Woolrich Woolen Mills	47	47	47	47
Wundies Inc	132	132	132	132
Total	52,745	52,813	52,870	52,927

TABLE 53

MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 6
TOTAL USE

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Antrim Mining Co Inc(1)	GW	4	4	4	4
Antrim Mining Co Inc(2)	GW	66,900	66,900	66,900	66,900
Avery Coal Co Inc	SW	1,000	1,000	1,000	1,000
Fisher Mining Co Inc(1)	GW	8	8	8	8
Fisher Mining Co Inc(2)	SW	27	27	27	27
Fisher Mining Co Inc(3)	GW	499,000	499,000	499,000	499,000
Total		566,939	566,939	566,939	566,939

TABLE 54

MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 6
CONSUMPTIVE USE

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Antrim Mining Co Inc(1)	1	1	1	1
Antrim Mining Co Inc(2)	11,900	11,900	11,900	11,900
Avery Coal Co Inc	179	179	179	179
Fisher Mining Co Inc(1)	1	1	1	1
Fisher Mining Co Inc(2)	5	5	5	5
Fisher Mining Co Inc(3)	89,100	89,100	89,100	89,100
Total	101,186	101,186	101,186	101,186

4. Agricultural Water Use

Total livestock and irrigation water use are estimated to be 0.70 MGD and 0.95 MGD, respectively. Consumption by livestock and irrigation are estimated to be 0.52 MGD and 0.80 MGD.

5. Summary of Water Use in Subbasin Section 6

Tables 55 and 56 summarize estimates of water use in Section 6 through the year 2010.

B. OCCURRENCE OF Q7-10 VALUE

Occurrence of flows at or below the Q7-10 value in the West Branch Susquehanna River at Williamsport is summarized in Table 63, page 108, and Figures 13 and 14, pages 109 and 110.

TABLE 55

TOTAL WATER USE SUMMARY FOR SECTION 6*

User	Total Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	6.46	6.34	6.33	6.40
Industrial				
Non-Mineral Self-Supplied	0.82	0.82	0.82	0.82
Mineral Self-Supplied	0.57	0.57	0.57	0.57
Agriculture				
Livestock	0.70	0.70	0.70	0.70
Irrigation	0.95	0.95	0.95	0.95
TOTAL	9.50	9.38	9.37	9.44
	(14.70 cfs)	(14.51 cfs)	(14.50 cfs)	(14.61 cfs)

* Assuming potential low flow conditions.

TABLE 56

CONSUMPTIVE WATER USE SUMMARY FOR SECTION 6*

User	Consumptive Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	1.29	1.27	1.27	1.28
Industrial				
Non-Mineral Self-Supplied	0.05	0.05	0.05	0.05
Mineral Self-Supplied	0.10	0.10	0.10	0.10
Agriculture				
Livestock	0.52	0.52	0.52	0.52
Irrigation	0.80	0.80	0.80	0.80
TOTAL	2.76	2.74	2.74	2.75
	(4.27 cfs)	(4.24 cfs)	(4.24 cfs)	(4.26 cfs)

* Assuming potential low flow conditions.

X. SUBBASIN SECTION 7

WEST BRANCH SUSQUEHANNA RIVER FROM MOUTH OF PINE CREEK TO AND INCLUDING LYCOMING CREEK

A. WATER USE

1. Municipal Water Use

Baseline water use data for the five public systems withdrawing water from Section 7 are summarized in Table 57. Water use projections for the section are summarized in Table 58. Total water use is expected to decrease from the baseline estimate of 7.61 MGD to 5.49 MGD in 2010. Consumption is estimated to be 1.52 MGD under baseline conditions and 1.10 MGD in 2010.

2. Self-Supplied Non-Mineral Industrial Water Use

The eleven non-mineral industrial withdrawals in Section 7 have small total and consumptive uses which are not expected to increase significantly (Tables 59 and 60).

3. Self-Supplied Mineral Industrial Water Use

The Pa. DER reported no mineral industry withdrawals in Section 7.

4. Agricultural Water Use

Total livestock and irrigation water use are estimated to be 0.21 MGD and 0.38 MGD, respectively. Livestock and irrigation consumption are estimated to be 0.16 MGD and 0.32 MGD.

TABLE 57

BASELINE MUNICIPAL WATER USE DATA FOR SECTION 7
OF THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

Municipal System Name	Source	Pop. on System	Avg. Water Use (gpd)	GPCD	Peak Water Use (gpd)	Peak/Avg. Ratio
Collomsville Water Co.	SW	289	22,000	76.1	33,000	1.50
Ralston Water & Power Co.	GW,SW	313	23,600	75.4	35,400	1.50
Rauchtown Water Co. Inc.	SW	550	8,473	15.4	21,013	2.48
Roaring Br. Water Assn.	GW	56	2,706	48.4	4,059	1.50
Williamsport Mun. Water Auth.*	GW,SW	53,713	7,554,500	140.6	9,065,400	1.20
TOTAL		54,921	7,611,279		9,158,872	

* Uses water from Sections 7 and 9, but greatest withdrawal is from Section 7.

TABLE 58

MUNICIPAL WATER USE PROJECTIONS FOR SECTION 7

Parameter	Base	1990	2000	2010
Population Served	54,921	47,947	42,508	40,053
Avg. Daily Water Use (gpd)	7,611,279	6,620,606	5,836,237	5,489,200
Consumptive Use (gpd)	1,522,256	1,324,121	1,167,247	1,097,840
Peak Water Use (gpd)	9,158,872	7,972,792	7,033,140	6,617,244

TABLE 59
NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 7
TOTAL USE

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Cummings Lumber Co.	GW	100	100	100	100
Fine Art Woodcarving	GW	5	5	5	5
James H Horner	GW	1	1	1	1
Knittle & Frey	GW	300	342	378	414
Lemco Tool Corp	GW	505	505	505	505
Palmer Ind Coatings	GW	394	394	394	394
Pleasant Valley Process Co	GW	125	149	171	194
R&B Trust Co	GW	1,450	1,450	1,450	1,450
Short Mt. Spring Water	GW	650	741	819	897
Wmspt. Steel Rule Die Ser	GW	18	18	18	18
Winters Sawmill	SW	4	4	4	4
Total		3,552	3,709	3,845	3,982

TABLE 60
NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 7
CONSUMPTIVE USE

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Cummings Lumber Co.	8	8	8	8
Fine Art Woodcarving	0	0	0	0
James H Horner	0	0	0	0
Knittle & Frey	21	24	27	30
Lemco Tool Corp	22	22	22	22
Palmer Ind Coatings	17	17	17	17
Pleasant Valley Process Co	10	11	13	15
R&B Trust Co	64	64	64	64
Short Mt. Spring Water	46	53	59	64
Wmspt. Steel Rule Die Ser	1	1	1	1
Winters Sawmill	0	0	0	0
Total	189	200	211	221

5. Summary of Water Use in Subbasin Section 7

Tables 61 and 62 summarize estimates of water use in Section 7 through the year 2010.

B. OCCURRENCE OF Q7-10 VALUE

Table 63 and Figures 13 and 14 summarize the occurrence of flows at or below the Q7-10 value in the West Branch Susquehanna River at Williamsport. Flows at or below the Q7-10 value have been documented in January, July, August, September, October, November, and December of various years. Flows of this magnitude occurred during more days in 1930 than in any other year of record.

TABLE 61

TOTAL WATER USE SUMMARY FOR SECTION 7*

User	Total Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	7.61	6.62	5.84	5.49
Industrial				
Non-Mineral Self-Supplied	<0.01	<0.01	<0.01	<0.01
Mineral Self-Supplied	0	0	0	0
Agriculture				
Livestock	0.21	0.21	0.21	0.21
Irrigation	0.38	0.38	0.38	0.38
TOTAL	8.20	7.21	6.43	6.08
	(12.69 cfs)	(11.16 cfs)	(9.95 cfs)	(9.41 cfs)

* Assuming potential low flow conditions.

TABLE 62

CONSUMPTIVE WATER USE SUMMARY FOR SECTION 7*

User	Consumptive Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	1.52	1.32	1.17	1.10
Industrial				
Non-Mineral Self-Supplied	<0.01	<0.01	<0.01	<0.01
Mineral Self-Supplied	0	0	0	0
Agriculture				
Livestock	0.16	0.16	0.16	0.16
Irrigation	0.32	0.32	0.32	0.32
TOTAL	2.00	1.80	1.65	1.58
	(3.09 cfs)	(2.79 cfs)	(2.55 cfs)	(2.44 cfs)

* Assuming potential low flow conditions.

TABLE 63

FLOWS AT OR BELOW THE 7-DAY 10-YEAR LOW FLOW VALUE
FOR WEST BRANCH SUSQUEHANNA RIVER AT WILLIAMSPORT, PA.
(USGS SITE NO. 01551500)

Calendar Year	No. of Days Occurred	Months Occurred/ No. Days Per Month
1895	5	Jul./1, Sept./3, Oct./1
1913	7	Sept./7
1930	69	Sept./4, Oct./27, Nov./25 Dec./13
1931	27	Jan./27
1932	24	Sept./23, Oct./1
1939	25	Aug./3, Sept./22
1940	1	Oct./1
1941	3	Sept./1, Oct./2
1943	10	Sept./10
1951	5	Oct./5
1964	6	Nov./6
1983	1	Sept./1
TOTAL	183	Jan./27, Jul./1, Aug./3 Sept./71, Oct./37, Nov./31 Dec./13

FIGURE 13

NUMBER OF DAYS 7-DAY 10-YEAR LOW FLOW OCCURRED DURING PERIOD 1894 – 1986 WEST BRANCH SUSQUEHANNA RIVER @ WILLIAMSPORT

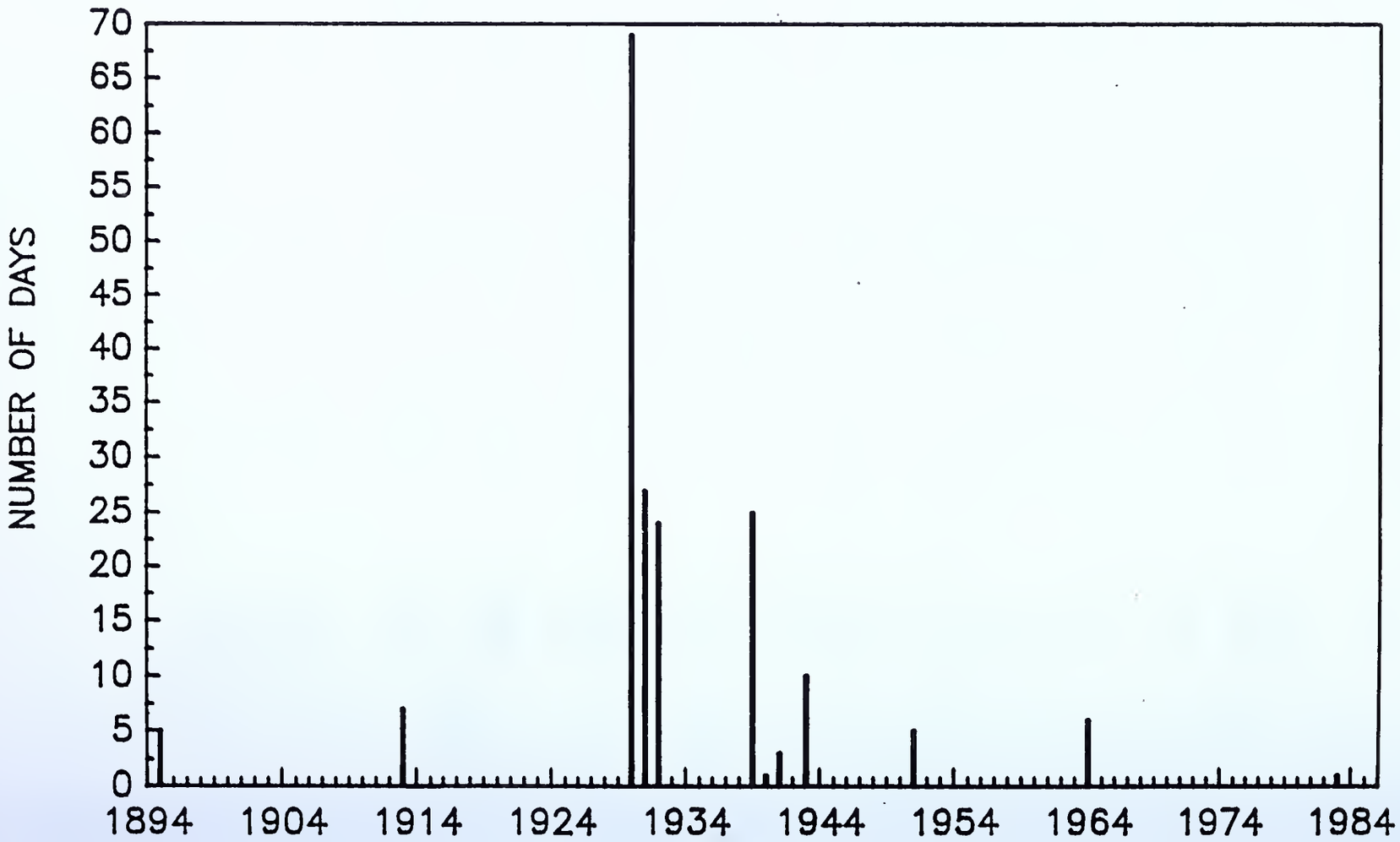
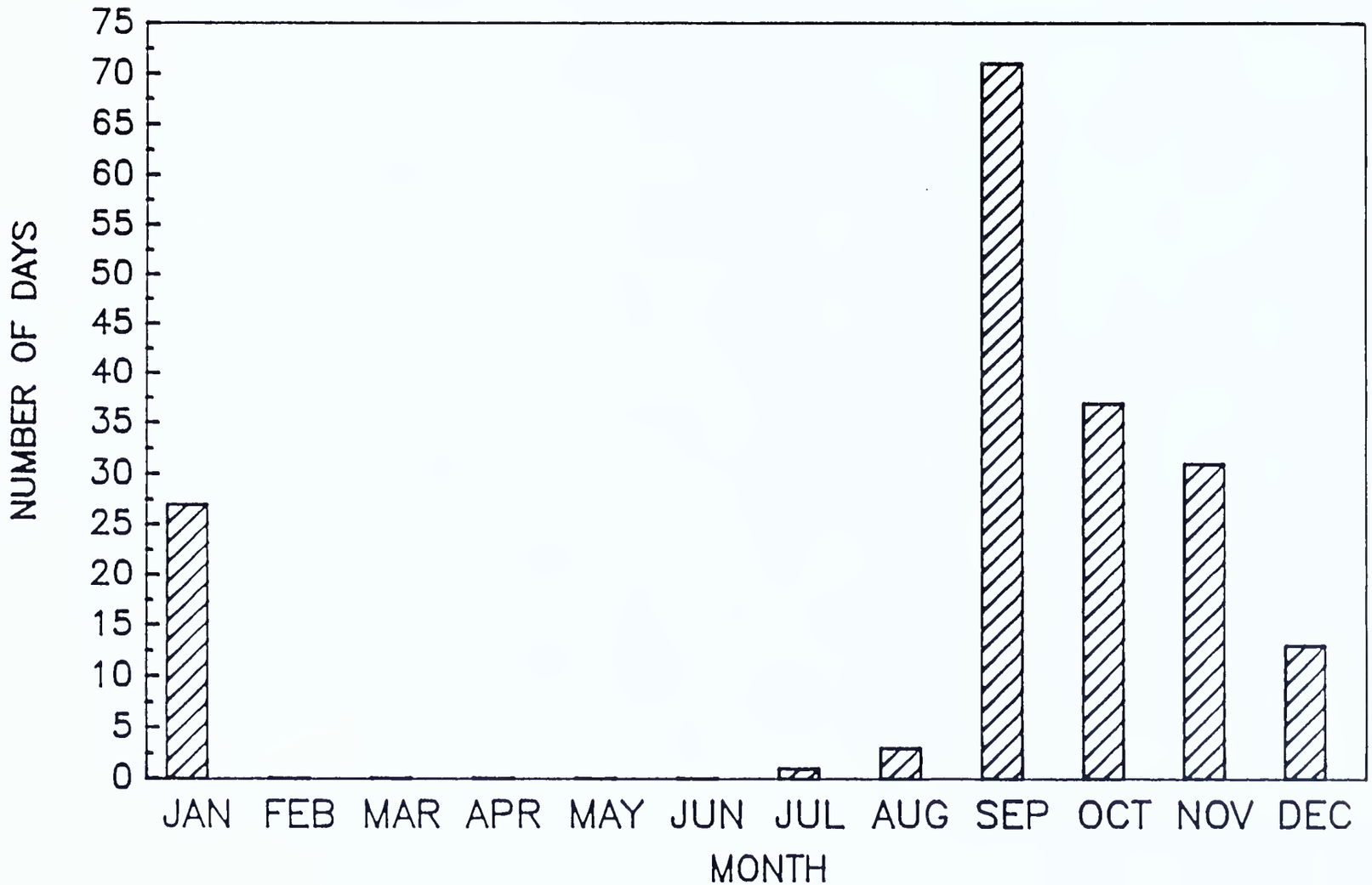


FIGURE 14

NUMBER OF DAYS 7-DAY 10-YEAR LOW FLOW OCCURRED IN EACH MONTH
WEST BRANCH SUSQUEHANNA @ WILLIAMSPORT
(FOR PERIOD 1894 – 1986)



XI. SUBBASIN SECTION 8

LOYALSOCK CREEK

A. WATER USE

1. Municipal Water Use

Baseline water use data for the two public systems withdrawing water from Section 8 are summarized in Table 64. Water use projections for the section are summarized in Table 65. Total water use is expected to decrease from the baseline estimate of 0.13 MGD to 0.10 MGD in 2010. Consumption is estimated to be 0.03 MGD under baseline conditions and 0.02 in 2010.

2. Self-Supplied Non-Mineral Industrial Water Use

Total water use by self-supplied non-mineral industries is estimated to be 0.02 MGD. Consumptive use is less than 0.01 MGD (Tables 66 and 67). Water use is projected to remain constant through 2010.

3. Self-Supplied Mineral Industrial Water Use

The only company making mineral industry withdrawals in Section 8 is First Century, which has three ground-water withdrawals totalling about 0.00545 MGD. An estimated 0.000436 MGD of First Century's withdrawals are consumed. No increases are projected through the year 2010.

TABLE 64

BASELINE MUNICIPAL WATER USE DATA FOR SECTION 8
OF THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

Municipal System Name	Source	Pop. on System	Avg. Water Use (gpd)	GPCD	Peak Water Use (gpd)	Peak/Avg. Ratio
Dushore Boro Waterworks	GW,SW	663	93,460	141.1	110,283	1.18
Laporte Boro Water Supply	GW,SW	230	35,000	152.2	39,900	1.14
TOTAL		893	128,460		150,183	

TABLE 65

MUNICIPAL WATER USE PROJECTIONS FOR SECTION 8

Parameter	Base	1990	2000	2010
Population Served	893	824	762	721
Avg. Daily Water Use (gpd)	128,460	118,760	109,970	104,110
Consumptive Use (gpd)	25,692	23,752	21,994	20,822
Peak Water Use (gpd)	150,183	138,761	128,433	121,542

TABLE 66

NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 8
TOTAL USE

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Baumunk Lumber	GW	300	300	300	300
John M Fink Lumber	GW	200	200	200	200
Keystone State Shoe Co., Inc.	GW	1,360	1,360	1,360	1,360
L Baumonk & Son	GW	252	252	252	252
Marathon Carey-McFall Co.	GW	16,100	16,100	16,100	16,100
Pneu-Dart Inc.	GW	32	32	32	32
Rheem Textile Sys	GW	1,000	1,000	1,000	1,000
Sullivan Metals Inc(1)	GW	38	38	38	38
Sullivan Metals Inc(2)	SW	38	38	38	38
Total		19,320	19,320	19,320	19,320

TABLE 67

NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 8
CONSUMPTIVE USE

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Baumunk Lumber	23	23	23	23
John M Fink Lumber	15	15	15	15
Keystone State Shoe Co., Inc.	85	85	85	85
L Baumonk & Son	19	19	19	19
Marathon Carey-McFall Co.	1,150	1,150	1,150	1,150
Pneu-Dart Inc.	2	2	2	2
Rheem Textile Sys	42	42	42	42
Sullivan Metals Inc(1)	2	2	2	2
Sullivan Metals Inc(2)	2	2	2	2
Total	1,340	1,340	1,340	1,340

4. Agricultural Water Use

Total livestock and irrigation water use are estimated to be 0.20 MGD and 0.21 MGD, respectively. Livestock and irrigation consumption are estimated to be 0.15 MGD and 0.18 MGD.

5. Summary of Water Use in Subbasin Section 8

Water use in Section 8 is modest in comparison to water use in most other subbasin sections. Estimates for Section 8 are summarized in Tables 68 and 69.

B. OCCURRENCE OF Q7-10 VALUE

Table 70 and Figures 15 and 16 summarize the recorded occurrence of flows at or below the Q7-10 value in Loyalsock Creek at Loyalsockville. Flows at or below the Q7-10 value have been documented in August, September, October, and November of various years. Flows of this magnitude occurred during more days in 1964 than in any other year of record.

TABLE 68

TOTAL WATER USE SUMMARY FOR SECTION 8*

User	Total Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	0.13	0.12	0.11	0.10
Industrial				
Non-Mineral Self-Supplied	0.02	0.02	0.02	0.02
Mineral Self-Supplied	0.01	0.01	0.01	0.01
Agriculture				
Livestock	0.20	0.20	0.20	0.20
Irrigation	0.21	0.21	0.21	0.21
TOTAL	0.57 (0.88 cfs)	0.56 (0.87 cfs)	0.55 (0.85 cfs)	0.54 (0.84 cfs)

* Assuming potential low flow conditions.

TABLE 69

CONSUMPTIVE WATER USE SUMMARY FOR SECTION 8*

User	Consumptive Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	0.03	0.02	0.02	0.02
Industrial				
Non-Mineral Self-Supplied	<0.01	<0.01	<0.01	<0.01
Mineral Self-Supplied	<0.01	<0.01	<0.01	<0.01
Agriculture				
Livestock	0.15	0.15	0.15	0.15
Irrigation	0.18	0.18	0.18	0.18
TOTAL	0.36 (0.56 cfs)	0.35 (0.54 cfs)	0.35 (0.54 cfs)	0.35 (0.54 cfs)

* Assuming potential low flow conditions.

TABLE 70

FLOWS AT OR BELOW THE 7-DAY 10-YEAR LOW FLOW VALUE
FOR LOYALSOCK CREEK AT LOYALSOCKVILLE, PA.
(USGS SITE NO. 01552000)

Calendar Year	No. of Days Occurred	Months Occurred/ No. Days Per Month
1932	17	Sept./17
1939	20	Aug./1, Sept./19
1953	4	Aug./1, Sept./3
1962	3	Sept./3
1964	79	Sept./30, Oct./26, Nov./23
1980	17	Aug./6, Sept./11
TOTAL	140	Aug./8, Sept./83, Oct./26 Nov./23

FIGURE 15

NUMBER OF DAYS 7-DAY 10-YEAR LOW FLOW OCCURRED DURING PERIOD 1925 – 1986 LOYALSOCK CREEK @ LOYALSOCKVILLE

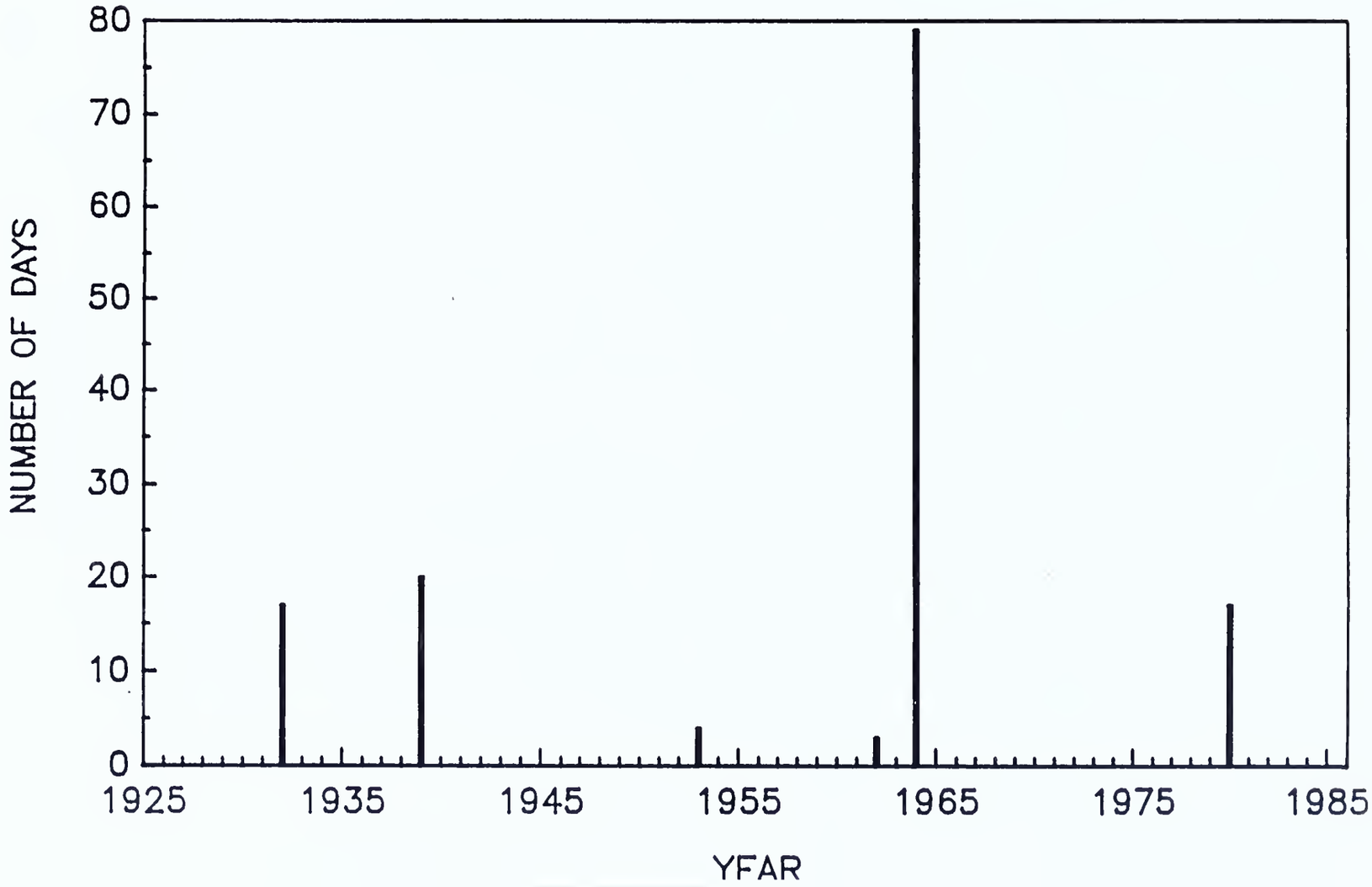
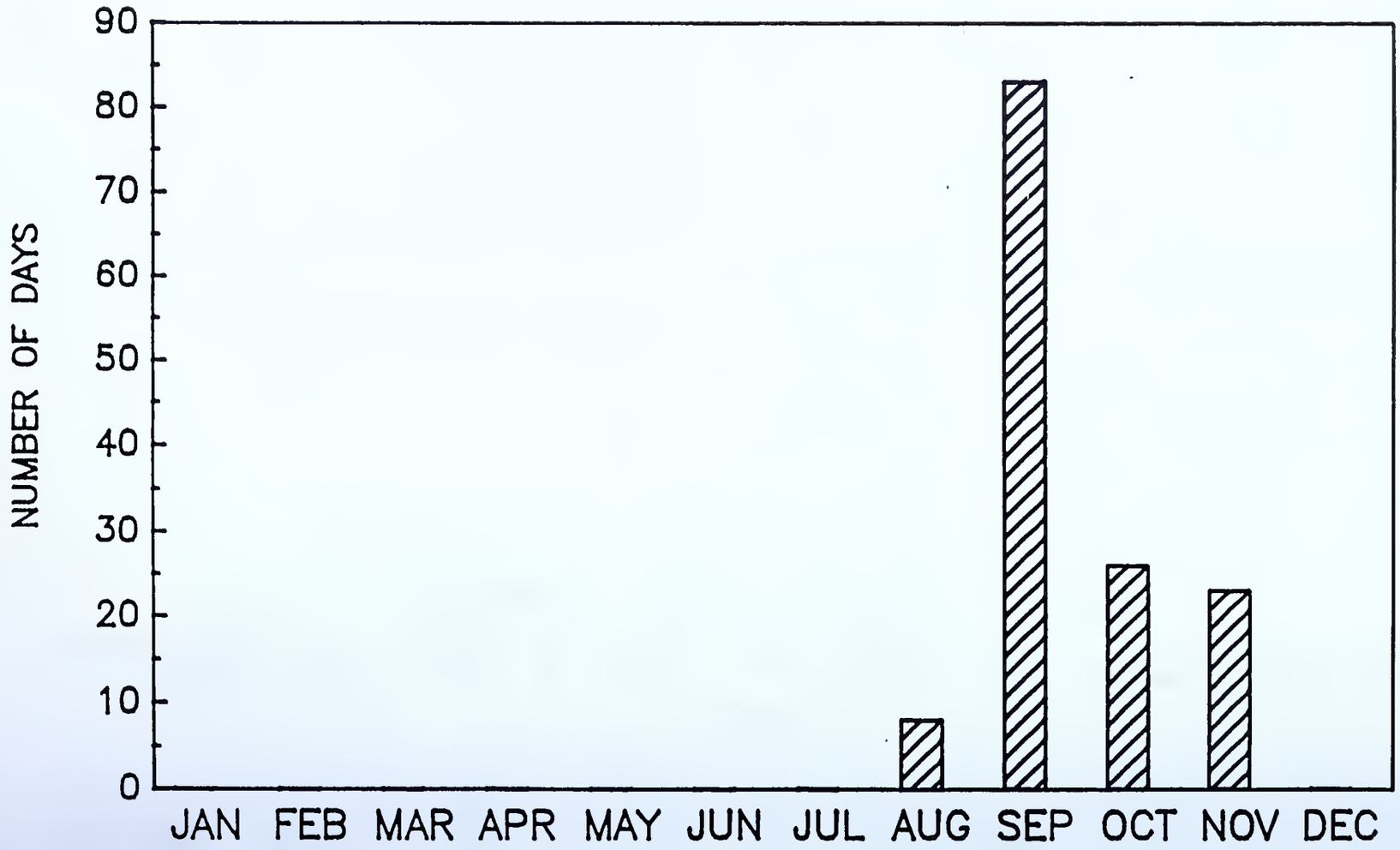


FIGURE 16

NUMBER OF DAYS 7-DAY 10-YEAR LOW FLOW OCCURRED
IN EACH MONTH
LOYALSOCK CREEK @ LOYALSOCKVILLE
(FOR PERIOD 1925 – 1986)



XII. SUBBASIN SECTION 9

WEST BRANCH SUSQUEHANNA RIVER BELOW LYCOMING CREEK EXCEPT LOYALSOCK CREEK

A. WATER USE

1. Municipal Water Use

Baseline water use data for the thirteen public systems withdrawing water from Section 9 are summarized in Table 71. Water use projections for the section are summarized in Table 72. Total water use is expected to increase from the baseline estimate of 10.32 MGD to 10.52 MGD in 2010. Consumption is estimated to be 2.06 MGD under baseline conditions and 2.10 MGD in 2010.

2. Self-Supplied Non-Mineral Industrial Water Use

Total water use by non-mineral industries in Section 9 is expected to increase from about 34.28 MGD under baseline conditions to about 35.99 MGD in 2010 (Table 73). Non-mineral industrial water consumption is greater in Section 9 than in all other sections of the subbasin combined. Consumption by non-mineral industries in Section 9 is estimated to be 19.50 MGD for the base year and 20.83 MGD in 2010 (Table 74).

3. Self-Supplied Mineral Industrial Water Use

Mineral industries in Section 9 have a combined total withdrawal of about 2.28 MGD and consume about 0.13 MGD. Water use is projected to remain constant through 2010 (Tables 75 and 76).

TABLE 71

BASELINE MUNICIPAL WATER USE DATA FOR SECTION 9
OF THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

Municipal System Name	Source	Pop. on System	Avg. Water Use (gpd)	GPCD	Peak Water Use (gpd)	Peak/Avg. Ratio
Allenwood Prison Camp	GW	640	138,000	215.6	314,640	2.28
Bella Vista Water Co.	GW	147	9,270	63.0	9,270	1.00
Eagles Mere Water Co.	SW	202	22,400	111.1	84,896	3.79
Gregg Twp. Auth.	GW	299	20,500	68.6	26,650	1.30
Hughesville Boro Water Co.	GW	2,238	417,000	186.3	625,500	1.50
McEwensville Mun. Water Auth.	GW	247	15,000	60.7	15,000	1.00
Mifflinburg Mun. Waterworks	SW	3,151	350,000	111.1	374,500	1.07
Montgomery Water & Sewer Auth.	GW,SW	1,998	240,500	120.1	531,505	2.21
Montoursville Mun. Waterworks*	GW,SW	5,403	1,020,000	188.8	2,560,200	2.51
Muncy Boro Water Dept.	GW,SW	3,105	524,400	168.8	875,748	1.67
Muncy State Correctional Institution	GW,SW	500	38,500	77.0	60,445	1.57
Pa. American Water Co. White Deer District	SW	34,380	7,463,570	217.3	8,732,377	1.17
Turbotville Water Co.	SW	699	60,370	86.4	90,555	1.50
TOTAL		53,009	10,319,510		14,301,286	

* Has sources in both Sections 8 & 9, but primary source is in Section 9.

TABLE 72

MUNICIPAL WATER USE PROJECTIONS FOR SECTION 9

Parameter	Base	1990	2000	2010
Population Served	53,009	53,579	53,381	53,310
Avg. Daily Water Use (gpd)	10,319,510	10,494,470	10,506,480	10,516,080
Consumptive Use (gpd)	2,063,902	2,098,894	2,101,296	2,103,216
Peak Water Use (gpd)	14,301,286	14,328,474	14,113,792	13,964,134

TABLE 73

NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 9
TOTAL USE

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Agway Inc(1)	GW	7,600	8,660	9,580	10,500
Agway Inc(2)	GW	3,710	4,230	4,670	5,120
Agway Inc(3)	GW	7,600	7,600	7,600	7,600
American Home Foods	GW	13,300	15,200	16,800	18,400
Bechtel Bros	GW	1,240	1,410	1,560	1,710
Bituminous Emulsion	GW	11,400	11,400	11,400	11,400
Ceco Corporation	GW	4,270	4,270	4,270	4,270
Construction Specialities	GW	33,200	33,200	33,200	33,200
Data Papers Inc	GW	497	591	681	770
Dr. Davies Product Co	GW	19	19	19	19
Eagle Enterprises	GW	160	160	160	160
Faylor Middlecreek	GW	59,600	59,600	59,600	59,600
Furman Canning	GW	148,000	169,000	186,000	204,000
George M. Firth	GW	3,400	3,400	3,400	3,400
Glen Gery Corp	GW	6,280	6,280	6,280	6,280
Gold Bond Building	GW	342,000	383,000	451,000	520,000
Greenleaf Crop Prod	GW	75	75	75	75
Grit Publishing	GW	15,400	18,300	21,100	23,900
GTE Products	GW	162,000	162,000	162,000	162,000
Harrison Bros	GW	5,770	6,580	7,270	7,960
H&E Mfg Co Inc	GW	22,000	22,000	22,000	22,000
Herr Milling Co	GW	20	23	25	28
Ice House of Lewisburg	GW	114,000	130,000	144,000	157,000
Interstate Amiesite(1)	GW	1,250	1,250	1,250	1,250
Interstate Amiesite(2)	SW	1,100	1,100	1,100	1,100
J&J Lumber & Pallet Co	GW	24	24	24	24
Keeler/Dorr Oliver Boiler	GW	1,000	1,000	1,000	1,000
Keystone Filler&Mfg	GW	490	490	490	490
Keystone Friction Hinge	GW	423	423	423	423
Koppers Co(1)*	GW	60,000	390,000	390,000	390,000
Koppers Co(2)	GW	81,600	81,600	81,600	81,600
Marquart Lumber	GW	86	86	86	86
Milesburg Energy, Inc*	GW	0	1,080,000	1,080,000	1,080,000
Milton Mfg Co	GW	112,000	112,000	112,000	112,000
Muncy Homes Inc	GW	2,250	2,250	2,250	2,250
Muncy Machine & Tool Co Inc	GW	475	475	475	475
Nite-Lite Sign Co	GW	60	60	60	60
OWL Industries Inc	GW	175	175	175	175

* Based on SRBC Project Review Files (Dec. 1987).

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Prismo Universal Corp(1)	GW	8,760	8,760	8,760	8,760
Prismo Universal Corp(2)	GW	1,560	1,560	1,560	1,560
PP&L Montour Units 1,2&11**	SW	33,000,000	33,000,000	33,000,000	33,000,000
RH Odell Inc	GW	24	24	24	24
Susquehanna Supply	GW	1,250	1,250	1,250	1,250
Turbotville Dress	GW	800	800	800	800
Waldmann & Assocs	GW	1,280	1,680	1,800	1,930
Watsontown Brick	GW	3,930	3,930	3,930	3,930
West Company	GW	34,300	34,300	34,300	34,300
Williamsport Newcrete	GW	1,000	1,000	1,000	1,000
Wolynic & Son Inc	GW	1,050	1,050	1,050	1,050
Zechmans Flour Mills	GW	110	125	139	152
Total		34,276,538	35,772,410	35,878,236	35,985,081

** From Susquehanna River Basin Electric Utilities Group (1986).

TABLE 74

NON-MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 9
CONSUMPTIVE USE

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Agway Inc(1)	543	619	685	751
Agway Inc(2)	265	302	334	366
Agway Inc(3)	511	511	511	511
American Home Foods	951	1,090	1,200	1,320
Bechtel Bros	89	101	112	122
Bituminous Emulsion	1,730	1,730	1,730	1,730
Ceco Corporation	188	188	188	188
Construction Specialities	1,460	1,460	1,460	1,460
Data Papers Inc	38	46	52	59
Dr. Davies Product Co	1	1	1	1
Eagle Enterprises	10	10	10	10
Faylor Middlecreek	9,060	9,060	9,060	9,060
Furman Canning	10,600	12,100	13,300	14,600
George M. Firth	210	210	210	210
Glen Gery Corp	823	823	823	823
Gold Bond Building	26,400	29,600	34,900	40,200
Greenleaf Crop Prod	5	5	5	5
Grit Publishing	1,190	1,410	1,620	1,840
GTE Products	11,500	11,500	11,500	11,500
Harrison Bros	413	470	520	569
H&E Mfg Co Inc	1,690	1,690	1,690	1,690
Herr Milling Co	1	2	2	2
Ice House of Lewisburg	8,150	9,300	10,300	11,200
Interstate Amiesite(1)	190	190	190	190
Interstate Amiesite(2)	167	167	167	167
J&J Lumber & Pallet Co	2	2	2	2
Keeler/Dorr Oliver Boiler	44	44	44	44
Keystone Filler&Mfg	33	33	33	33
Keystone Friction Hinge	19	19	19	19
Koppers Co(1)*	6,000	237,000	237,000	237,000
Koppers Co(2)	3,450	3,450	3,450	3,450
Marquart Lumber	7	7	7	7
Milesburg Energy, Inc*	0	1,080,000	1,080,000	1,080,000
Milton Mfg Co	6,910	6,910	6,910	6,910
Muncy Homes Inc	173	173	173	173
Muncy Machine & Tool Co Inc	21	21	21	21
Nite-Lite Sign Co	3	3	3	3
OWL Industries Inc	11	11	11	11

* Based on SRBC Project Review Files (Dec. 1987).

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Prismo Universal Corp(1)	371	371	371	371
Prismo Universal Corp(2)	105	105	105	105
PP&L Montour Units 1,2&11**	19,400,000	19,400,000	19,400,000	19,400,000
RH Odell Inc	3	3	3	3
Susquehanna Supply	164	164	164	164
Turbotville Dress	62	62	62	62
Waldmann & Assocs	0	0	0	0
Watsontown Brick	515	515	515	515
West Company	1,780	1,780	1,780	1,780
Williamsport Newcrete	131	131	131	131
Wolynic & Son Inc	138	138	138	138
Zechmans Flour Mills	8	9	10	11
Total	19,496,135	20,813,536	20,821,522	20,829,527

** From Susquehanna River Basin Electric Utilities Group (1986). Values cited in a 1987 update of this report were calculated using a methodology different from that used for the 1986 report. The 1986 values were larger and were considered by SRBC staff to be more representative of a worst case analysis.

TABLE 75

MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 9
TOTAL USE

Withdrawal	Source	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Lime Bluff Quarry(1)	GW	11	11	11	11
Lime Bluff Quarry(2)	GW	206,000	206,000	206,000	206,000
Milton Quarry	GW	89,900	89,900	89,900	89,900
Montour Pit & Plant(1)	GW	256	256	256	256
Montour Pit & Plant(2)	SW	1,590,000	1,590,000	1,590,000	1,590,000
Watsontown Brick Co(1)	GW	40	40	40	40
Watsontown Brick Co(2)	GW	11,300	11,300	11,300	11,300
Winfield Quarry(1)	GW	121,000	121,000	121,000	121,000
Winfield Quarry(2)	GW	182,000	182,000	182,000	182,000
Winfield Quarry(3)	GW	77,000	77,000	77,000	77,000
Total		2,277,507	2,277,507	2,277,507	2,277,507

TABLE 76

MINERAL INDUSTRIAL WITHDRAWALS IN SECTION 9
CONSUMPTIVE USE

Withdrawal	Base (gpd)	1990 (gpd)	2000 (gpd)	2010 (gpd)
Lime Bluff Quarry(1)	1	1	1	1
Lime Bluff Quarry(2)	13,800	13,800	13,800	13,800
Milton Quarry	6,020	6,020	6,020	6,020
Montour Pit & Plant(1)	13	13	13	13
Montour Pit & Plant(2)	83,000	83,000	83,000	83,000
Watsontown Brick Co(1)	5	5	5	5
Watsontown Brick Co(2)	1,330	1,330	1,330	1,330
Winfield Quarry(1)	8,110	8,110	8,110	8,110
Winfield Quarry(2)	12,200	12,200	12,200	12,200
Winfield Quarry(3)	5,160	5,160	5,160	5,160
Total	129,639	129,639	129,639	129,639

4. Agricultural Water Use

Agriculture uses and consumes more water in Section 9 than in any other section of the subbasin. Total water use by livestock through the year 2010 is estimated to be about 0.72 MGD, with about 0.54 MGD consumed.

Information in the SRBC project review file for the Pennsylvania Power & Light Company's (PP&L's) Montour Agribusiness Center was considered and included in irrigation estimates for Section 9. Total irrigation water use for the base year through 1990 is estimated to be 1.29 MGD, with about 1.10 MGD consumed. Total irrigation water use for the period 2000 through 2010 is estimated to be about 1.75 MGD, with about 1.51 MGD consumed.

5. Summary of Water Use in Subbasin Section 9

Estimates of water use in Section 9 of the West Branch Susquehanna River Subbasin are contained in Tables 77 and 78. Although total water use is greatest in Section 3, consumptive use is greater in Section 9 than in any other section of the subbasin.

B. OCCURRENCE OF Q7-10 VALUE

Table 79 and Figures 17 and 18 summarize the occurrence of flows at or below the Q7-10 value in the West Branch Susquehanna River at Lewisburg. Flows at or below the Q7-10 value have been

TABLE 77

TOTAL WATER USE SUMMARY FOR SECTION 9*

User	Total Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	10.32	10.49	10.51	10.52
Industrial				
Non-Mineral Self-Supplied	34.28	35.77	35.88	35.99
Mineral Self-Supplied	2.28	2.28	2.28	2.28
Agriculture				
Livestock	0.72	0.72	0.72	0.72
Irrigation	1.29	1.29	1.75	1.75
TOTAL	48.89	50.55	51.14	51.26
	(75.65 cfs)	(78.22 cfs)	(79.13 cfs)	(79.32 cfs)

* Assuming potential low flow conditions.

TABLE 78

CONSUMPTIVE WATER USE SUMMARY FOR SECTION 9*

User	Consumptive Use (MGD)			
	Base	1990	2000	2010
Municipal				
Domestic & Industry	2.06	2.10	2.10	2.10
Industrial				
Non-Mineral Self-Supplied	19.50	20.81	20.82	20.83
Mineral Self-Supplied	0.13	0.13	0.13	0.13
Agriculture				
Livestock	0.54	0.54	0.54	0.54
Irrigation	1.10	1.10	1.51	1.51
TOTAL	23.33	24.68	25.10	25.11
	(36.10 cfs)	(38.19 cfs)	(38.84 cfs)	(38.85 cfs)

* Assuming potential low flow conditions.

TABLE 79

FLOWS AT OR BELOW THE 7-DAY 10-YEAR LOW FLOW VALUE
FOR WEST BRANCH SUSQUEHANNA RIVER AT LEWISBURG, PA.
(USGS SITE NO. 01553500)

Calendar Year	No. of Days Occurred	Months Occurred/ No. Days Per Month
1939	1	Oct./1
1941	1	Oct./1
1943	8	Sept./8
1963	28	Oct./23, Nov./5
1964	66	Sept./24, Oct./20, Nov./22
1965	1	Jul./1
1966	5	Aug./3, Sept./2
1983	1	Sept./1
TOTAL	111	Jul./1, Aug./3, Sept./35 Oct./45, Nov./27

FIGURE 17

NUMBER OF DAYS 7-DAY 10-YEAR LOW FLOW OCCURRED DURING PERIOD 1939 – 1987 WEST BRANCH SUSQUEHANNA RIVER @ LEWISBURG

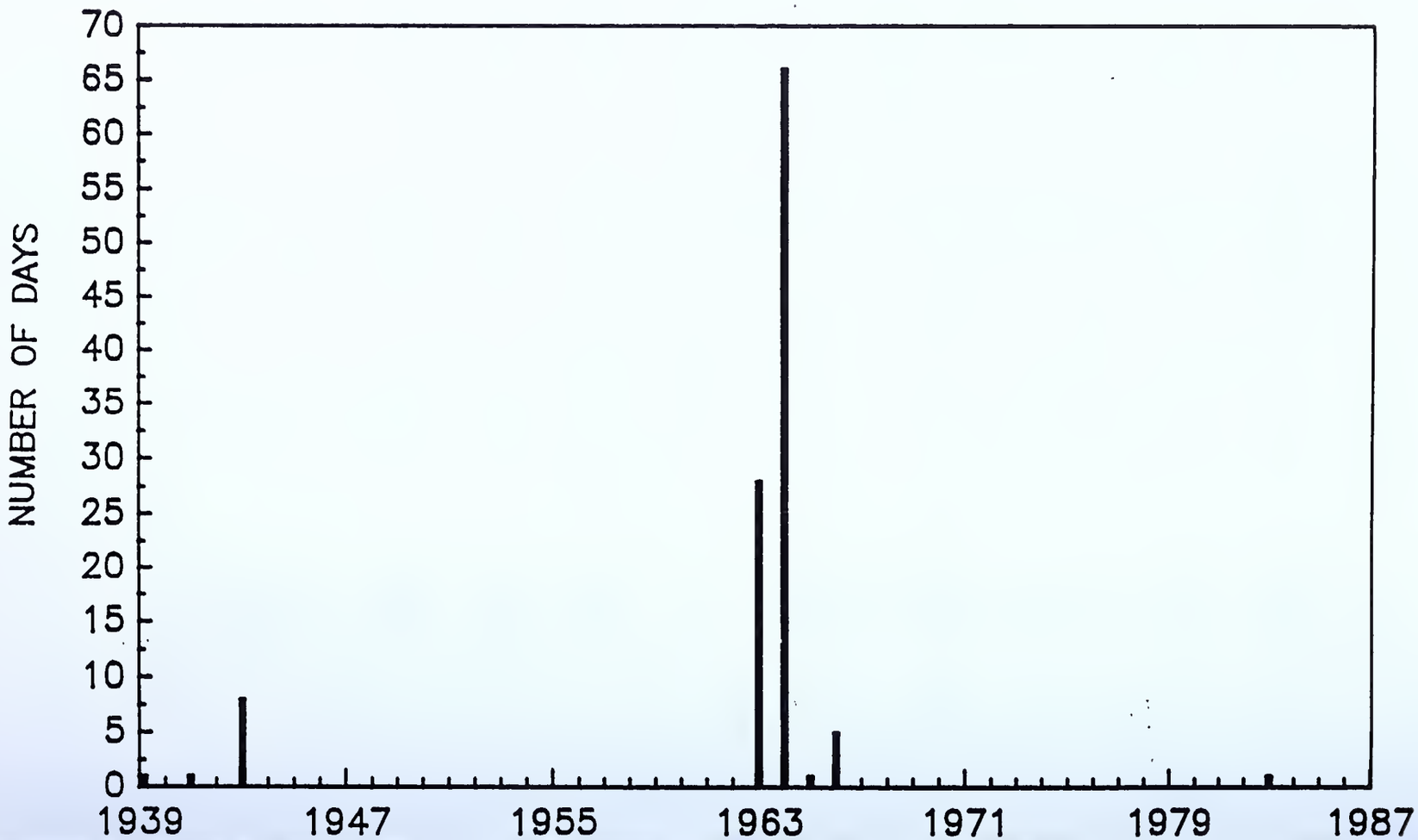
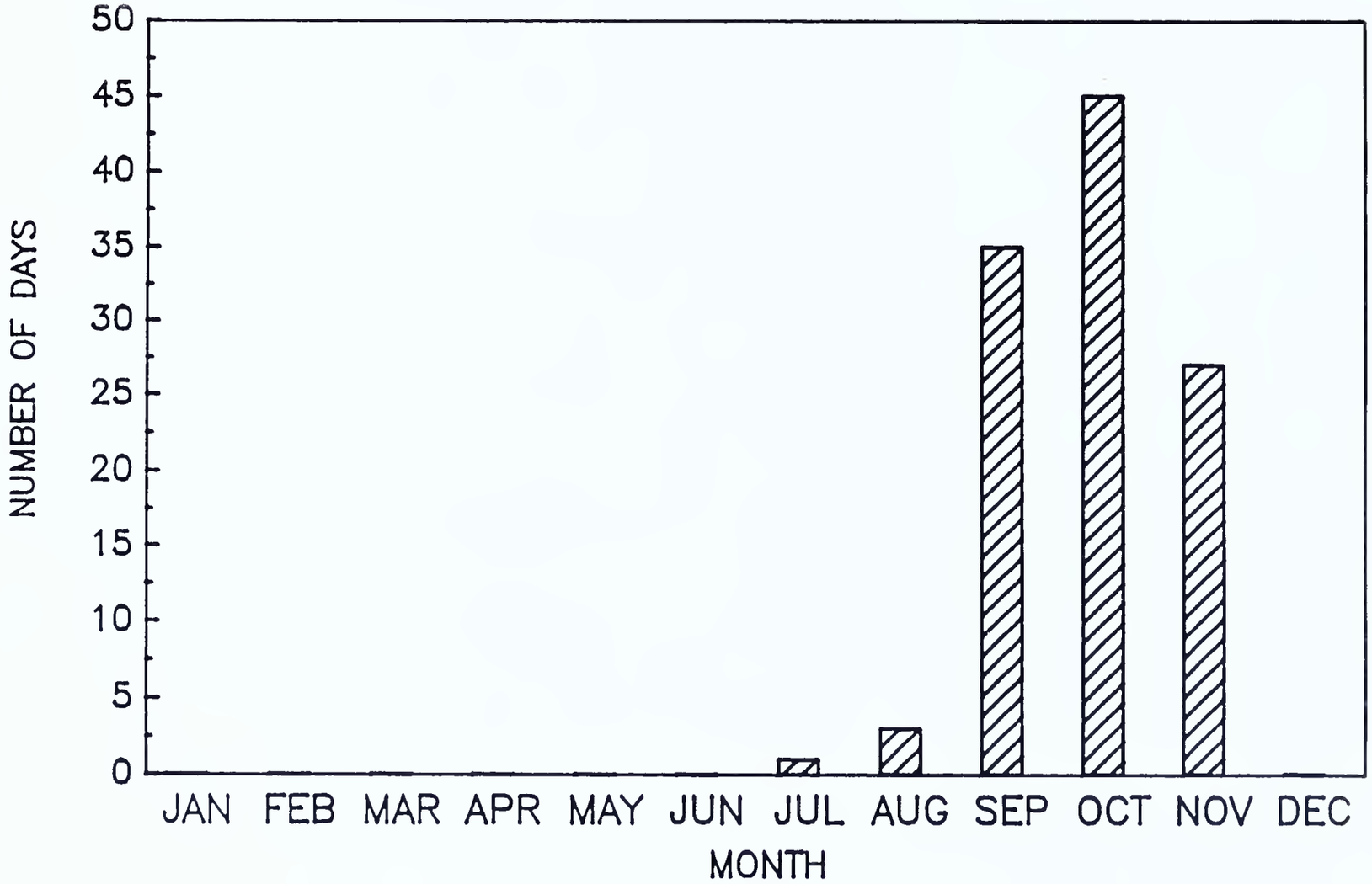


FIGURE 18

NUMBER OF DAYS 7-DAY 10-YEAR LOW FLOW OCCURRED IN EACH MONTH WEST BRANCH SUSQUEHANNA @ LEWISBURG

(FOR PERIOD 1939 – 1987)



documented in July, August, September, October, and November of various years. Flows of this magnitude occurred during more days in 1964 than in any other year of record.

XIII. PRESENT AND FUTURE LOW FLOW PROBLEMS AND NEEDS

A. GENERAL

A primary goal of this framework plan is to assist in the management of stream flows during periods of low water availability. Adequate stream flows provide pollution assimilation capability, support aquatic life, provide recreational opportunities, and provide water for municipal and industrial uses. From a basinwide perspective, the SRBC places high priority on the maintenance of flows for protection of the Chesapeake Bay.

Instream flow needs are not precisely known. However, regulatory agencies have focused on the Q7-10 value as a minimum flow considered in establishing state water quality standards and National Pollutant Discharge Elimination System (NPDES) permit limitations, and in designing municipal sewage treatment plants. The SRBC's consumptive use regulation (18 CFR Section 803.61) focuses upon preventing new consumptive water uses from further reducing stream flows when natural flows are less than or equal to the Q7-10 value.

Stream flows less than the Q7-10 value may not create undesirable conditions in all streams under all circumstances. The SRBC framework plans use the Q7-10 value as a target to allow comparison of potential water deficits during a defined frequency low flow event. The Q7-10 value is used for comparison purposes

and is not considered to be the minimum acceptable flow which must be maintained.

A water shortage may be caused by man's actions under two general types of conditions. First, a shortage may occur at any given point if stream flow is less than a specific withdrawal and the quantity of instream flow desired downstream of the withdrawal. For example, a stream flow of 50 cfs at a given location would generally be insufficient to provide water for instream needs of 48 cfs plus a municipal withdrawal of 5 cfs at the same location.

A man-induced water shortage could occur when aggregated upstream consumptive uses plus the desired minimum flow exceed the available stream flow. In many instances, much of the water withdrawn from the stream is ultimately returned, primarily by way of industrial and municipal treatment plant outfalls. However, many uses consume a portion of the water withdrawn. Consumption permanently removes water from the stream system, thereby affecting the entire length of stream below the point of withdrawal. An example of a water shortage caused by man's consumptive use is given in the following paragraph.

The minimum flow requirement at the mouth of a stream is 18 cfs. During a particular event with a given set of climatological conditions, flows in the stream fell to 18.5 cfs at the mouth. This particular low flow event occurred under

"natural" conditions during a historical period when the watershed was undeveloped and consumptive use by man was essentially zero. The watershed was subsequently developed and the cumulative water consumption from all surface withdrawals increased to 2 cfs. If the meteorological conditions causing the previous low flow event were repeated, flows at the stream mouth would be 16.5 cfs (18.5 cfs natural flow minus 2 cfs consumptive use). Since the desired minimum flow is 18 cfs, a man-induced water shortage attributable to consumptive use would occur.

In planning for periods of low water availability, it should be noted that the presence of water does not guarantee that it can be used for all desired purposes. Pollution can render water supplies unfit for some uses, or require that costly treatment processes be implemented.

B. AGGREGATED CONSUMPTIVE USE AND MAINTENANCE OF THE Q7-10 VALUE

Table 80 provides estimates of the aggregated upstream consumptive uses having the potential to affect stream flows at the outlet of each section of the West Branch Susquehanna River Subbasin. Table 81 summarizes storage requirements that would be needed to maintain the Q7-10 value at the outlet of each subbasin section, considering the aggregate upstream consumptive use. In general, upstream consumption is relatively small in comparison to the Q7-10 value at the outlet of subbasin sections.

TABLE 80

TOTAL CONSUMPTIVE USE UPSTREAM OF THE OUTLET OF EACH SECTION OF THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

Section Outlet & Location	Upstream Consumption (cfs)			
	Base	1990	2000	2010
1 Mouth of Sinnemahoning Creek	0.56	0.56	0.54	0.54
2 W. Br. Susq. R. above Mouth of Clearfield Crk.	4.47	4.43	4.41	4.39
3 W. Br. Susq. R. above Mouth of Moshannon Crk.	14.03	13.98	13.96	13.94
4 W. Br. Susq. R. above Mouth of Sinnemahoning Crk.	16.66	16.61	16.62	16.60
5 Mouth of Bald Eagle Crk.	7.29	7.43	7.66	7.81
6 W. Br. Susq. River below Mouth of Pine Creek	28.78	28.84	29.06	29.21
7 W. Br. Susq. River below Mouth of Lycoming Creek	31.87	31.63	31.61	31.65
8 Mouth of Loyalsock Creek	0.56	0.54	0.54	0.54
9 Mouth of W. Br. Susq. R.	68.53	70.36	70.99	71.04

TABLE 81

STORAGE REQUIREMENTS TO MAINTAIN THE 7-DAY 10-YEAR LOW FLOW VALUE AT THE OUTLET OF EACH SECTION OF THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

Section Outlet	Most Critical Period (Climatic Yr.)	Gage Used For Analysis	Section Q7-10 (cfs)	Storage Needed (Acre-Feet) Base	1990	2000	2010
1	1939	5435	19.5	276.1	276.1	275.3	275.3
2	1930	5410	40.1	1711.2	1701.6	1696.7	1691.9
3	1943	5425	109.8	1218.1	1214.9	1213.7	1212.3
	1930*			3911	3890	3878	3866
4	1943	5425	157.2	2406.8	2403.6	2404.2	2403.0
	1930*			5599	5568	5552	5536
5	1930	5480	160.7	5681.9	5715.5	5770.6	5806.7
6	1930	5515	426.4	18849.8	18862.7	18909.9	18942.0
7	1930	5515	468.9	20775.6	20724.0	20719.8	20728.4
8	1964	5520	24.5	988.6	985.4	985.4	985.4
9	1964	5535	676.0	19966.3	20237.7	20237.7	20244.8
	1930*			25500	25500	25500	25500

* Estimated from other main stem stations with gage records that included 1930-31 drought event.

C. OTHER CONSIDERATIONS

1. Acid Mine Drainage and Low Flows

McMorran (1985) reported that acid mine drainage is the most important factor influencing water quality in the West Branch Susquehanna River Subbasin. Acid mine drainage is produced by a series of chemical reactions which occur when pyritic material is exposed to water in the presence of oxygen. Kemp (1967) cited three dangers to aquatic life resulting from acid mine drainage:

- lowered pH due to production of sulfuric acid,
- reduction of dissolved oxygen content of water due to conversion of ferrous to ferric iron, and
- the presence of precipitates of ferric hydroxide and basic ferric sulfate, which blanket the bottom of the stream and smother aquatic life.

When considering the effects of pH on aquatic life, it is important to note that lowered pH increases the solubility of toxic metals. The increased availability of these metals usually stresses or kills aquatic organisms before the drop in pH alone does.

The impacts associated with acid mine discharges are highly dependent on the hydrologic relationship between the source of mine drainage and the receiving stream. In situations where the source of mine drainage is relatively constant, the impact on the receiving stream may be increased during low flow events.

Bore holes and springs carrying pollutants from extensive deep mining operations often continue to flow during low flow events, when less water is available for dilution in the receiving stream. As a result, stream pH and dissolved oxygen levels may drop and be accompanied by a heavy buildup of iron precipitates, dissolved metals, and solids.

Runoff from strip mines and coal refuse piles is generally more intermittent, and may be less important during low flow events. In contrast, wet conditions at these sites can cause water to leach through acid-causing materials, releasing large "slugs" of acid to the receiving stream.

Some inadequately restored surface mines can serve as catch basins for surface runoff. Acid water from these catch basins may percolate underground or overflow to surface streams during rainy periods.

A report prepared for the SRBC by Skelly & Loy (1973) cites that the largest single source of acid mine drainage in the subbasin is abandoned deep mines. In general, the greatest effect on biota caused by deep mine discharges would be expected during low flow events. Slugs of acid from surface mines and refuse piles are also a problem in the subbasin, but generally occur during periods of greater surface runoff.

2. Data Needs

General. Complications often arose in the development of water use estimates due to either a lack of information or the incompatibility of data from various sources. Numerous assumptions had to be made to allow the development of data presented in this report.

No system for monitoring irrigation during actual low flow periods presently exists. Although agricultural censuses are performed once every four years, census years do not necessarily coincide with dry years having heavy irrigation and low stream flows.

Irrigation water use data developed by Cornell University (Steenhuis and others, 1986) were used to prepare consumptive use estimates for both the Chemung Subbasin Low Flow Management Framework Plan (Heicher and others, 1987) and the Eastern Subbasin Low Flow Management Framework Plan (Heicher and Hirschel, 1988). However, similar data are not available for the West Branch Susquehanna River Subbasin, or any of the other subbasins in Pennsylvania. Commission staff feel that the development of data using the Cornell methodology would produce irrigation estimates somewhat greater than those cited in this report. In the future, it may be desirable to use the Cornell

methodology to develop irrigation estimates for this and the remaining subbasins in Pennsylvania.

Desired Flows to the Chesapeake Bay. The Chesapeake Bay Study (U.S. Army Corps of Engineers, 1984c) states that decreases in the amount of fresh water to the Bay have had serious environmental, social, and economic impacts in the past and are expected to have more significant impacts in the future. The problem is aggravated during low flow periods.

Section III.A.16. (Guidelines and Criteria) of the Commission's Comprehensive Plan states that "Low flows to the Chesapeake Bay shall not be reduced. Low flow to the Chesapeake Bay is defined as the one-in-twenty year average monthly low flow in each of the months of August, September, and October." The SRBC is currently working with the State of Maryland to determine freshwater flow requirements to the Bay. Until this information is available, it is impossible to determine the degree to which maintenance of the Q7-10 value at the mouth of the West Branch Susquehanna River Subbasin would contribute to the achievement of target freshwater flow requirements to the Chesapeake Bay.

XIV. ALTERNATIVE MANAGEMENT ACTIONS

A. GENERAL

Two categories of management actions were considered with respect to maintenance of minimum stream flows.

- Implement water conservation measures, and
- Provide water from surface water reservoirs.

In considering the above actions, it should be noted that over the long term, flow management would increase stream levels during low flows and therefore increase the Q7-10 values over a period of years.

B. WATER CONSERVATION

Consultation with Pa. DER staff indicates that in an emergency situation, municipal systems implementing conservation measures are commonly able to achieve a 25 percent savings in water used. Water conservation may be an excellent way to avoid the depletion of municipal and industrial water supplies, but would provide only minor benefits to streamflows. Consumptive use is relatively small in comparison to the Q7-10 value at the mouths of major streams in the West Branch Susquehanna River Subbasin. For this reason, conservation could not provide the volumes of water needed to maintain flows equal to Q7-10 levels during the most critical year at the subbasin or section level.

C. SURFACE WATER RESERVOIRS

1. Potential Releases From Existing Reservoirs

During the fall of each year, two of the three U.S. Army Corps of Engineers reservoirs in the subbasin (Curwensville and Blanchard) are drawn down from summer to winter pool capacity. A total of about 27,140 acre feet are released from the two reservoirs during the fall drawdown. Of this amount, about 4640 acre feet are released from Curwensville and 22,500 acre feet are released from Blanchard Reservoir. If this water were available for low flow management purposes, drawdown of Curwensville Reservoir from summer to winter pool capacity would theoretically be sufficient to maintain Q7-10 flows downstream at the outlets of Sections 2 and 3 during a repeat of the most critical year of record. The difference between summer and winter pool capacity in Blanchard Reservoir would be sufficient to maintain Q7-10 flows downstream at the outlets of Sections 5, 6, and 7 during a repeat of the most critical year of record. Combined releases from the two reservoirs would be sufficient to maintain Q7-10 flows at the mouth of the West Branch Susquehanna River Subbasin if meteorological conditions during the most critical year of record were repeated. Releases from the above impoundments would have no effect on flows in Sections 1 or 8, or in any tributary streams to the West Branch Susquehanna River except Bald Eagle Creek.

The feasibility of making releases from Curwensville and/or Blanchard Reservoir has not been thoroughly investigated. To

consider this possibility further, detailed coordination with the Baltimore District, U.S. Army Corps of Engineers would be required.

The Baltimore District has stated that any change in the regulation of Corps reservoirs in the West Branch Susquehanna River Subbasin would have to be evaluated for impacts to each project's environmental and recreational resources. Specifically, low flow release scenarios for Curwensville Lake and Blanchard Reservoir discussed in this report may adversely affect the existing state and county recreational facilities, and the in-lake and downstream fishery resources. In addition, the Baltimore District stated that the use of reservoir storage for flow augmentation may result in a change to a project's authorized purposes and attendant cost allocation.

The Baltimore District, Corps of Engineers is currently preparing a reconnaissance report for the Corps' Chesapeake Bay and Tributaries Reallocation Study (Chesapeake Bay - Susquehanna River Drought Management Study). The purpose of the reallocation study is to examine a wide range of water resource problems (flood control, water supply, recreation, etc.). They expect that potential solutions to those problems will emphasize reallocation of storage at existing projects, development of new storage projects, and development of a basinwide systems management plan for reservoir operation.

2. New Reservoir Sites

Potential reservoir sites in the West Branch Susquehanna River Subbasin were identified by the Susquehanna River Basin Study Coordinating Committee (1970) and the U. S. Army Corps of Engineers (1986b). Information regarding these sites is summarized in Appendix B. Potential site locations and reservoir storage capacities described by the above are listed in Table 82.

Although Table 82 identifies vast quantities of storage associated with reservoir sites that were considered in the past, the present economic, environmental and social costs of developing one or more of these sites for low flow management purposes are unknown. Additional investigations would be required to determine the feasibility of reservoir construction for low flow management at any site. A general discussion of social and political considerations pertinent to potential reservoir development is included as Appendix D.

TABLE 82

LOCATIONS & STORAGE CAPACITIES OF RESERVOIR SITES PREVIOUSLY IDENTIFIED IN WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

Location	Storage Capacity (Acre Ft.)
SECTION 1 - Sinnemahoning Creek	
Dents Run	6,985
Wilson Run	1,280
South Branch-Bennett Branch	4,820
Mountain Run	6,290
SECTION 1 TOTAL	19,375
SECTION 2 - W. Br. Susquehanna River Above Clearfield Creek	
Beaver Run	3,650
Bigler Run	2,175
Harlett Run	4,480
SECTION 2 TOTAL	10,305
SECTION 3 - Clearfield Creek & W. Br. Susq. River From Clearfield Creek to Moshannon Creek	
Alex Branch Trout Run	1,665
Gifford Run	960
SECTION 3 TOTAL	2,625
SECTION 4 - Moshannon Creek & W. Br. Susq. River From Moshannon Creek to Sinnemahoning Creek	
Little Laurel Run	4,675
Six Mile Run	3,010
Little Beaver Run	1,920
SECTION 4 TOTAL	9,605
SECTION 5 - Bald Eagle Creek	
Swamp Branch Big Run	1,120
East Branch Big Run	585
SECTION 5 TOTAL	1,705

SECTION 6 - W. Br. Susquehanna River From Mouth of Sinnemahoning Creek to & including Pine Creek

Left Branch Asaph Run	350
Right Branch Asaph Run	260
Babb Creek	2,585
West Branch Pine Creek	8,120
Nine Mile Run	5,150
Pine Creek	10,400
Keating (W. Br. Susquehanna River)	1,220,000
Cammal (Pine Creek)	528,000
SECTION 6 TOTAL	1,774,865

SECTION 7 - W. Br. Susquehanna River From Mouth of Pine Creek to & including Lycoming Creek

Larrys Creek	1,760
SECTION 7 TOTAL	1,760

SECTION 8 - Loyalsock Creek

Mill Creek	2,450
Big Run	1,360
Loyalsock Creek	12,255
Joe Grey Run	690
West Branch Wallis Run	1,100
SECTION 8 TOTAL	17,855

SECTION 9 - W. Br. Susquehanna River Below Lycoming Creek Except Loyalsock Creek

Little Muncy Creek	20,530
Turtle Creek	2,550
Muncy Creek	61,500
West Branch Chillisquaque Creek	1,660
Beaver Run	2,710
SECTION 9 TOTAL	88,950
TOTAL FOR ENTIRE SUBBASIN	1,927,045

From Susquehanna River Basin Study Coordinating Committee (1970) and U.S. Army Corps of Engineers (1986b).

XV. CONCLUSIONS

This report uses the Q7-10 value as an indicator to identify historical low flow periods, and to determine potential water deficits within watersheds during a repeat of the most severe historical low flow period. In general, upstream consumptive use presently ranges from about 2 percent to 11 percent of the Q7-10 value at the outlets of major stream sections in the subbasin.

Total consumptive use in the subbasin under baseline low flow conditions is estimated to be 44.29 MGD (68.53 cfs). Consumptive use during potential low flow conditions in the year 2010 is projected to be about 45.91 MGD (71.04 cfs). More than half of the subbasin's total consumptive use occurs in Section 9.

This report estimates that if meteorological conditions producing the 1930 drought were repeated under present conditions, about 25,500 acre feet of water would be required to maintain Q7-10 flows at the mouth of the West Branch Susquehanna River. About the same amount of water would be required if the 1930 drought were to be repeated in the year 2010. The amount of water storage needed to maintain flows at the Q7-10 value at the outlet of each stream section is also provided in this report.

A more thorough knowledge of minimum instream flow requirements and the fresh water requirements of the

Chesapeake Bay are required to establish definitive low flow goals for key locations in the West Branch Susquehanna River Subbasin.

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APPENDIX A

SUPPORTING DATA FOR INDUSTRIAL WATER USE CALCULATIONS

DEPARTMENT OF ENVIRONMENTAL RESOURCES

Consumptive Water Use for 2-digit SIC Groups in per cent of Total Water Withdrawal

FILE NO

SECTION NO

SHEET NO

COMPUTED BY CHECKED BY DATE 7/2/71

MADE IN CONNECTION WITH

SIC	Consumptive Use (%)	Comments
All	7.70	*
20	17.15	*
21	16.7	*
22	11.7	*
23	7.70	**
24	7.70	**
25	0.00	*
26	7.73	*
27	7.70	**
28	6.72	*
29	15.2	*
30	5.19	*
31	6.25	*
32	13.1	*
33	6.17	*
34	4.41	*
35	4.23	*
36	7.09	*
37	6.39	*
38	5.26	*
39	7.14	*

* Computed from Table 1A, page 7-16, from "1967 Census of Manufactures - Water Use in Manufacturing." MC67(1)-7 U.S. Department of Commerce

** No values were determined by the reference. Therefore the national average for all manufacturers was substituted.

15 Gallons per employee
30 Gallon " " with show

DEPARTMENT OF ENVIRONMENTAL RESOURCES

FWFC-D-10

SUBJECT Consumptive Water Use — Mineral Industies [derived from Table 6, page 17; of "Water Use In The Mineral Industry"; Bureau of Mines Information Circular #8285] FILE NO. SECTION NO. SHEET NO.

COMPUTED BY T.S.S. CHECKED BY DATE 7/18/74

MADE IN CONNECTION WITH

SIC		% Consumption of Withdrawal
1011	Iron Ore	6.13
1021	Copper Ore	37.43
1031	Lead and Zinc Ore	6.71
104	Gold and Silver Ore	1.18
1094	Uranium-Radium-Vanadium	42.00
111	Anthracite Coal	7.99
121	Bituminous Coal	17.85
131	Petroleum and Nat. Gas	90.98
132	Natural Gas Liquids	32.92
141	Dimension Stone	3.99
142	Crushed and Broken Stone	6.70
144	Sand and Gravel	5.22
145	Clay	11.74
1472	Barite	8.53
1474	Potash, Soda, Borate	39.47
1475	Phosphate Rock	25.59
1476	Rock Salt	23.92
1477	Sulfur	26.40
—	Other	8.85
—	Total	24.90

RATIO OF THE PROJECTED VALUE ADDED TO THE BASE YEAR 1980
FOR EACH GROWING TWO-DIGIT SIC GROUP IN PENNSYLVANIA

SIC CODE	INDUSTRY	PROJECTED VALUE ADDED RATIO		
		1990	2000	2010
20	Food & Kindred Products	1.14	1.26	1.38
25	Furniture & Fixtures	1.31	1.41	1.51
26	Paper & Allied Products	1.12	1.32	1.52
27	Printing & Publishing	1.19	1.37	1.55
38	Instruments; Photographic, Medical, & Optical Goods; Watches & Clocks	1.25	1.53	1.81

APPENDIX B

POTENTIAL RESERVOIR SITES IN THE WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

APPENDIX B

POTENTIAL RESERVOIR SITES
WEST BRANCH SUSQUEHANNA RIVER SUBBASIN

A. Susquehanna River Basin Coordinating Committee, 1970, Susquehanna River Basin Study, Appendix K(2), Vol 2, Structural Measures.

SECTION 1

1. Dents Run

   Type: Recreation and Fish Habitat
   Location: 4.5 miles west of Dents Run, PA.
   Drainage Area: 11.0 sq. miles
   Storage: 6,985 acre-feet
   Surface Area: 270 acres
   Note: Recommended for potential development by 2000

2. Wilson Run

   Type: Recreation and Fish Habitat
   Location: 1 mile north of Penfield, PA.
   Drainage Area: 8.0 sq. miles
   Storage: 1,280 ac-ft
   Surface Area: 83 acres
   Note: Recommended for potential development by 2020

3. South Branch - Bennett Branch

   Type: Recreation and Fish Habitat
   Location: 3 miles South of Penfield, PA.
   Drainage Area: 6.8 sq. miles
   Storage: 4,820 ac-ft
   Surface Area: 162 acres
   Note: Recommended for potential development by 2020

4. Mountain Run

   Type: Recreation and Fish Habitat
   Location: 2 miles southwest of Penfield, PA.
   Drainage Area: 10.7 sq. miles
   Storage: 6,290 ac-ft
   Surface Area: 225 acres
   Note: Recommended for potential development by 2020

SECTION 2

1. Beaver Run

   Type: Recreation and Fish Habitat
   Location: 2 miles east of Cherry Tree, PA.
   Drainage Area: 5.7 sq. miles
   Storage: 3,650 ac-ft
   Surface Area: No Data
   Note: Recommended for potential development by 1980

2. Bigler Run

   Type: Recreation
   Location: 4 miles northwest of Curwensville, PA.
   Drainage Area: 3.4 sq. miles
   Storage: 2,175 ac-ft
   Surface Area: 180 acres
   Note: Recommended for potential development by 1980

3. Harlett Run

   Type: Recreation and Fish Habitat
   Location: 3 miles northeast of Mahaffey, PA.
   Drainage Area: 7.0 sq. miles
   Storage: 4,480 ac-ft
   Surface Area: 160 acres
   Note: Recommended for potential development by 2020

SECTION 3

1. Alex Branch Trout Run

   Type: Recreation and Fishing
   Location: 10.5 miles northwest of Lecontes Mills, PA.
   Drainage Area: 2.6 sq. miles
   Storage: 1,665 ac-ft
   Surface Area: 122 acres
   Note: Recommended for potential development by 1980

2. Gifford Run

   Type: Recreation and Fishing
   Location: 8 miles northwest of Frenchville, PA.
   Drainage Area: 1.5 sq. miles
   Storage: 960 ac-ft
   Surface Area: 75 acres
   Note: Recommended for potential development by 1980

SECTION 4

1. Little Laurel Run

   Type: Water Supply
   Location: 3 miles northwest of Philipsburg, PA.
   Drainage Area: 7.3 sq. miles
   Storage: 4,675 ac-ft
   Surface Area: No Data
   Note: Recommended for potential development by 1980

2. Six Mile Run

   Type: Recreation and Fish Habitat
   Location: 6.5 miles southeast of Philipsburg, PA.
   Drainage Area: 4.7 sq. miles
   Storage: 3,010 ac-ft
   Surface Area: 120 acres
   Note: Recommended for potential development by 2000

3. Little Beaver Run

   Type: Recreation and Fish Habitat
   Location: 6 miles southwest of Philipsburg, PA.
   Drainage Area: 3.0 sq. miles
   Storage: 1,920 ac-ft
   Note: Recommended for potential development by 2000

SECTION 5

1. Swamp Branch Big Run

   Type: Recreation and Fishing
   Location: 7 miles north of Orviston, PA.
   Drainage Area: 2.1 sq. miles
   Storage: 1,120 ac-ft
   Surface Area: 116 acres
   Note: Recommended for potential development by 1980

2. East Branch Big Run

   Type: Recreation and Fish Habitat
   Location: 8 miles north of Orviston, PA.
   Drainage Area: 1.1 sq. miles
   Storage: 585 ac-ft
   Surface Area: 63 acres
   Note: Recommended for potential development by 2000

SECTION 6

1. Left Branch Asaph Run

   Type: Recreation and Fishing
   Location: No Data
   Drainage Area: No Data
   Storage: 350 ac-ft
   Surface Area: 30 acres
   Note: Recommended for potential development by 1980

2. Right Branch Asaph Run

   Type: Recreation and Fishing
   Location: 4.5 miles northwest of Asaph, PA.
   Drainage Area: 0.4 sq. miles
   Storage: 260 ac-ft
   Surface Area: No Data
   Note: Recommended for potential development by 1980

3. Babb Creek

   Type: Recreation and Fishing
   Location: 6 miles southeast of Wellsboro, PA
   Drainage Area: 4.9 sq. miles
   Storage: 2,585 ac-ft
   Surface Area: 235 acres
   Note: Recommended for potential development by 1980

4. West Branch Pine Creek

   Type: Recreation and Fish Habitat
   Location: 7 miles southwest of Galeton, PA.
   Drainage Area: 24.0 sq. miles
   Storage: 8,120 ac-ft
   Surface Area: 219 acres
   Note Recommended for potential development by 2020

5. Nine Mile Run

   Type: Recreation and Fish Habitat
   Location: 8 miles northwest of Galeton, PA.
   Drainage Area: 16.1 sq. miles
   Storage: 5,150 ac-ft
   Surface Area: 160 acres
   Note: Recommended for potential development by 2020

6. Pine Creek

   Type: Recreation and Fish Habitat
   Location: 1 mile west of Galeton, PA.
   Drainage Area: 29 sq. miles
   Storage: 10,400 ac-ft
   Surface Area: 320 acres
   Note: Recommended for potential development by 2020

SECTION 7

1. Larrys Creek

   Type: Recreation and Fishing
   Location: 1 mile northeast of Cogan House, PA.
   Drainage Area: 3.0 sq. miles
   Storage: 1,760 ac-ft
   Surface Area: 100 acres
   Note: Recommended for potential development by 1980

SECTION 8

1. Mill Creek

   Type: Recreation and Fishing
   Location: 5 miles northwest of Warrensville, PA.
   Drainage Area: 3.5 sq. miles
   Storage: 2,450 ac-ft
   Surface Area: 337 acres
   Note: Recommended for potential development by 1980

2. Big Run

   Type: Recreation and Fishing
   Location: 3 miles north of Picture Rocks, PA.
   Drainage Area: 2.3 sq. miles
   Storage: 1,360 ac-ft
   Surface Area: 80 acres
   Note: Recommended for potential development by 1980

3. Loyalsock Creek

   Type: Recreation and Fishing
   Location: 2.5 miles east of Lopez, PA.
   Drainage Area: 19.0 sq. miles
   Storage: 12,255 ac-ft
   Surface Area: 530 acres
   Note: Recommended for potential development by 1980

4. Joe Grey Run

   Type: Recreation and Fish Habitat
   Location: 7 miles northeast of Warrensville, PA.
   Drainage Area: 1.0 sq. mile
   Storage: 690 ac-ft
   Surface Area: 93 acres
   Note: Recommended for potential development by 2020

5. West Branch Wallis Run

Type: Recreation and Fish Habitat
Location: 9 miles northeast of Warrensville, PA.
Drainage Area: 1.7 sq. miles
Storage: 1,100 ac-ft
Surface Area: 78 acres
Note: Recommended for potential development by 2020

SECTION 9

1. Little Muncy Creek

Type: Recreation and Fishing
Location: 5 miles southeast of Hughesville, PA.
Drainage Area: 51.6 sq. miles
Storage: 20,530
Surface Area: 720 acres
Note: Recommended for potential development by 1980

2. Turtle Creek

Type: Recreation and Fishing
Location: north of Winfield, PA.
Drainage Area: 11.7 sq. miles
Storage: 2,550 ac-ft
Surface Area: 200 acres
Note: Recommended for potential development by 1980

3. Muncy Creek

Type: Recreation and Fishing
Location: Tivoli, PA.
Drainage Area: 79 sq. miles
Storage: 61,500 ac-ft
Surface Area: 1,270 acres
Note: Recommended for potential development by 2000

4. West Branch Chillisquaque Creek

Type: Recreation and Fishing
Location: 1 mile north of Exchange, PA.
Drainage Area: 5.8 sq. miles
Storage: 1,660 ac-ft
Surface Area: 104 acres
Note: Recommended for potential development by 2000

5. Beaver Run

Type: Recreation and Fishing
Location: 3 miles northeast of Landsville, PA.
Drainage Area: 8.9 sq. miles
Storage: 2,710 ac-ft
Surface Area: 170 acres
Note: Recommended for potential development by 2020

B. U.S. Army Corps of Engineers. September 1986b. Chesapeake Bay and Tributaries Reallocation Study - Final Limited Reconnaissance Report.

SECTION 6

1. Keating (W. Br. Susquehanna River)

Type: Multipurpose
Location: 4.2 Miles above Keating, PA.
Drainage Area: 1,574 sq. miles
Max. Storage: 1,220,000 ac-ft
Low Flow Augmentation Storage Available: 1,023,280ac-ft

2. Cammal (Pine Creek)

Type: Multipurpose
Location: 1 mile north of Cammal, PA.
Drainage Area: 682 sq. miles
Max. Storage: 528,000 ac-ft
Low Flow Augmentation Storage Available: 349,880 ac-ft

APPENDIX C

AGRICULTURAL WATER USE DATA

CAMBRIA COUNTY, PA. LIVESTOCK

Parameter	1982	1978	1974	1969	1964
Livestock Numbers*	46940	93912	82315	159117	119211
Milk Cows	2723	2616	3181	3240	4608
Other Cattle & Calves	9389	8847	8854	7694	8386
Swine	4566	6029	4434	4914	6008
Sheep & Lambs	476	859	432	480	864
Horses	550	451	258	486	?
Turkeys	456	147	862	413	?
Chickens	28780	74963	64294	141890	99345
Livestock Water Use (gpd)	213783	215598	217819	217522	256541
Milk Cows (25)	68075	65400	79525	81000	115200
Other Cattle & Calves (12)	112668	106164	106248	92328	100632
Swine (5.0)	22830	30145	22170	24570	30040
Sheep & Lambs (2.0)	952	1708	864	960	1728
Horses (12)	6600	5412	3096	5832	?
Turkeys (0.15)	68	22	129	62	?
Chickens (0.09)	2590	6747	5787	12770	8941
Livestock Consumptive Use (gpd)**	160357	161698	163364	163142	192406

* 1969 and 1974 data for turkeys and 1964 data for chickens include only farms with sales of $2,500 and over.

** Consumptive use was assumed to be 75% of total use.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, & 1982).

CAMERON COUNTY, PA. LIVESTOCK

Parameter	1982	1978	1974	1969	1964
Livestock Numbers*	550	478	815	830	3855
Milk Cows	?	?	150	142	125
Other Cattle & Calves	?	?	219	156	206
Swine	64	57	28	14	72
Sheep & Lambs	?	--	0	0	0
Horses	?	?	5	30	?
Turkeys	?	?	0	0	?
Chickens	486	421	413	488	3452
Livestock Water Use (gpd)	364	323	6615	5896	6268
Milk Cows (25)	?	?	3750	3550	3125
Other Cattle & Calves (12)	?	?	2628	1872	2472
Swine (5.0)	320	285	140	70	360
Sheep & Lambs (2.0)	?	?	0	0	0
Horses (12)	?	?	60	360	?
Turkeys (0.15)	?	?	0	0	?
Chickens (0.09)	44	38	37	44	311
Livestock Consumptive Use (gpd)**	273	242	4961	4422	4701

* 1969 and 1974 data for turkeys and 1964 data for chickens include only farms with sales of $2,500 and over.

** Consumptive use was assumed to be 75% of total use.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, & 1982).

CENTRE COUNTY, PA. LIVESTOCK

Parameter	1982	1978	1974	1969	1964
Livestock Numbers*	72941	91845	91562	97863	167323
Milk Cows	13591	13187	12307	12109	15224
Other Cattle & Calves	20424	18047	15540	13674	15890
Swine	5921	7074	5453	7724	8299
Sheep & Lambs	2354	2884	2082	1545	1955
Horses	1022	1005	610	737	?
Turkeys	?	767	9032	56	?
Chickens	29689	48881	46538	62010	125955
Livestock Water Use (gpd)	632612	603951	538447	522956	628021
Milk Cows (25)	338275	329675	387675	302725	380600
Other Cattle & Calves (12)	245088	216564	186480	164088	190680
Swine (5.0)	29605	35370	27265	38620	41495
Sheep & Lambs (2.0)	4708	5768	4164	3090	3910
Horses (12)	12264	12060	7320	8844	?
Turkeys (0.15)	?	115	1355	8	?
Chickens (0.09)	2672	4399	4188	5581	11336
Livestock Consumptive Use (gpd)**	474459	452963	403835	392217	471016

* 1969 and 1974 data for turkeys and 1964 data for chickens include only farms with sales of $2,500 and over.

** Consumptive use was assumed to be 75% of total use.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, & 1982).

CLEARFIELD COUNTY, PA. LIVESTOCK

Parameter	1982	1978	1974	1969	1964
Livestock Numbers*	15046	13842	70509	86566	102820
Milk Cows	3383	3319	3661	3559	4666
Other Cattle & Calves	6052	5291	5647	5641	7030
Swine	976	928	1308	1501	1617
Sheep & Lambs	435	469	1483	627	738
Horses	398	383	319	469	?
Turkeys	121	84	1520	340	?
Chickens	3681	3368	56571	74429	88769
Livestock Water Use (gpd)	168094	156957	177942	177804	218560
Milk Cows (25)	84575	82975	91525	88975	116650
Other Cattle & Calves (12)	72624	63492	67764	67692	84360
Swine (5.0)	4880	4640	6540	7505	8085
Sheep & Lambs (2.0)	870	938	2966	1254	1476
Horses (12)	4776	4596	3828	5628	?
Turkeys (0.15)	18	13	228	51	?
Chickens (0.09)	331	303	5091	6699	7989
Livestock Consumptive Use (gpd)**	126055	117717	133457	133353	163920

* 1969 and 1974 data for turkeys and 1964 data for chickens include only farms with sales of $2,500 and over.

** Consumptive use was assumed to be 75% of total use.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, & 1982).

CLINTON COUNTY, PA. LIVESTOCK

Parameter	1982	1978	1974	1969	1964
Livestock Numbers*	47817	44935	17930	45060	52959
Milk Cows	4462	3885	3057	3381	4051
Other Cattle & Calves	7306	6748	5360	5078	4834
Swine	2700	2573	1013	1188	1897
Sheep & Lambs	112	?	38	48	99
Horses	485	330	288	172	?
Turkeys	?	44	5	0	?
Chickens	32752	31355	8169	35193	41078
Livestock Water Use (gpd)	221714	197755	150078	156728	173753
Milk Cows (25)	111550	97125	76425	84525	101275
Other Cattle & Calves (12)	87672	80976	64320	60936	58008
Swine (5.0)	13500	12865	5065	5940	9485
Sheep & Lambs (2.0)	224	?	76	96	198
Horses (12)	5820	3960	3456	2064	?
Turkeys (0.15)	?	7	1	0	?
Chickens (0.09)	2948	2822	735	3167	3787
Livestock Consumptive Use (gpd)**	166286	148316	112559	117546	130315

* 1969 and 1974 data for turkeys and 1964 data for chickens include only farms with sales of $2,500 and over.

** Consumptive use was assumed to be 75% of total use.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, & 1982).

ELK COUNTY, PA. LIVESTOCK

Parameter	1982	1978	1974	1969	1964
Livestock Numbers*	3423	3848	129063	29851	40438
Milk Cows	947	1060	1373	1100	1446
Other Cattle & Calves	2037	2164	1664	1472	2006
Swine	167	324	176	226	394
Sheep & Lambs	?	?	2	365	177
Horses	238	214	138	113	?
Turkeys	34	86	8	0	?
Chickens	?	?	125702	26575	36415
Livestock Water Use (gpd)	51815	56669	68147	50772	65823
Milk Cows (25)	23675	26500	34325	27500	36150
Other Cattle & Calves (12)	24444	25968	19968	17664	24072
Swine (5.0)	835	1620	880	1130	1970
Sheep & Lambs (2.0)	?	?	4	730	354
Horses (12)	2856	2568	1656	1356	?
Turkeys (0.15)	5	13	1	0	?
Chickens (0.09)	?	?	11313	2392	3277
Livestock Consumptive Use (gpd)**	38961	42501	51110	38079	49367

* 1969 and 1974 data for turkeys and 1964 data for chickens include only farms with sales of $2,500 and over.

** Consumptive use was assumed to be 75% of total use.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, & 1982).

LYCOMING COUNTY, PA. LIVESTOCK

Parameter	1982	1978	1974	1969	1964
Livestock Numbers*	131478	113391	93225	94601	108876
Milk Cows	9167	8739	9836	9457	11911
Other Cattle & Calves	17178	12736	15996	13243	12831
Swine	6382	5920	5396	6549	6409
Sheep & Lambs	1065	982	753	964	653
Horses	592	678	734	811	?
Turkeys	515	424	604	65	?
Chickens	96579	83912	59906	63512	77072
Livestock Water Use (gpd)	485224	418623	480629	445472	492035
Milk Cows (25)	229175	218475	245900	236425	297775
Other Cattle & Calves (12)	206136	152832	191952	158916	153972
Swine (5.0)	31910	29600	26980	32745	32045
Sheep & Lambs (2.0)	2130	1904	1506	1928	1306
Horses (12)	7104	8136	8808	9732	?
Turkeys (0.15)	77	64	91	10	?
Chickens (0.09)	8692	7592	5392	5716	6937
Livestock Consumptive Use (gpd)**	363918	313967	360472	334104	369026

* 1969 and 1974 data for turkeys and 1964 data for chickens include only farms with sales of $2,500 and over.

** Consumptive use was assumed to be 75% of total use.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, & 1982).

MONTOUR COUNTY, PA. LIVESTOCK

Parameter	1982	1978	1974	1969	1964
Livestock Numbers*	16129	15638	32240	20180	67289
Milk Cows	2299	2374	2062	2410	2870
Other Cattle & Calves	4615	5459	4389	3988	4302
Swine	8668	7202	3942	2440	4250
Sheep & Lambs	228	169	269	334	171
Horses	281	362	194	168	?
Turkeys	38	72	0	57	?
Chickens	?	?	21384	10783	55687
Livestock Water Use (gpd)	160029	165561	128719	123970	150023
Milk Cows (25)	57475	59350	51550	60250	71750
Other Cattle & Calves (12)	55380	65508	52668	47856	51624
Swine (5.0)	43340	36010	19710	12200	21295
Sheep & Lambs (2.0)	456	338	538	668	342
Horses (12)	3372	4344	2328	2016	?
Turkeys (0.15)	6	11	0	9	?
Chickens (0.09)	?	?	1925	971	5012
Livestock Consumptive Use (gpd)**	120022	124171	96539	92978	112517

* 1969 and 1974 data for turkeys and 1964 data for chickens include only farms with sales of $2,500 and over.

** Consumptive use was assumed to be 75% of total use.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, & 1982).

NORTHUMBERLAND COUNTY, PA. LIVESTOCK

Parameter	1982	1978	1974	1969	1964
Livestock Numbers*	409047	364896	491733	448413	612167
Milk Cows	4945	4200	4737	5013	6402
Other Cattle & Calves	12300	12788	15374	13304	13438
Swine	29553	22811	16691	17758	11948
Sheep & Lambs	1536	1243	1563	1760	1804
Horses	414	743	475	471	?
Turkeys	31692	25374	5935	1237	?
Chickens	328607	292737	446958	408870	578575
Livestock Water Use (gpd)	461359	439065	436310	419917	436726
Milk Cows (25)	123625	105000	118425	125325	160050
Other Cattle & Calves (12)	147600	153456	184488	159648	161256
Swine (5.0)	147765	139055	83455	88790	59740
Sheep & Lambs (2.0)	3072	2486	3126	3520	3608
Horses (12)	4968	8916	5700	5652	?
Turkeys (0.15)	4754	3806	890	186	?
Chickens (0.09)	29575	26346	40226	36798	52072
Livestock Consumptive Use (gpd)**	346019	329299	327233	314939	327545

* 1969 and 1974 data for turkeys and 1964 data for chickens include only farms with sales of $2,500 and over.

** Consumptive use was assumed to be 75% of total use.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, & 1982).

POTTER COUNTY, PA. LIVESTOCK

Parameter	1982	1978	1974	1969	1964
Livestock Numbers*	19693	14053	90556	105170	78817
Milk Cows	6461	5925	6461	6215	8058
Other Cattle & Calves	9402	7125	8406	8105	6933
Swine	280	218	292	238	305
Sheep & Lambs	1146	527	708	1642	2475
Horses	263	258	236	280	?
Turkeys	72	?	106	0	?
Chickens	2069	?	74347	88690	61006
Livestock Water Use (gpd)	281394	238865	274812	268451	297092
Milk Cows (25)	161525	148125	161525	155375	201450
Other Cattle & Calves (12)	112824	85500	100872	97260	83676
Swine (5.0)	1400	1090	1460	1190	1525
Sheep & Lambs (2.0)	2292	1054	1416	3284	4950
Horses (12)	3156	3096	2832	3360	?
Turkeys (0.15)	11	?	16	0	?
Chickens (0.09)	186	?	6691	7982	5491
Livestock Consumptive Use (gpd)**	211046	179149	206109	201338	222819

* 1969 and 1974 data for turkeys and 1964 data for chickens include only farms with sales of $2,500 and over.

** Consumptive use was assumed to be 75% of total use.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, & 1982).

SULLIVAN COUNTY, PA. LIVESTOCK

Parameter	1982	1978	1974	1969	1964
Livestock Numbers*					
Milk Cows	9233	21350	9989	29061	29682
Other Cattle & Calves	2831	2677	2838	3073	3448
Swine	4276	4347	3496	3494	3559
Sheep & Lambs	239	304	218	366	255
Horses	390	192	200	736	743
Turkeys	157	114	155	155	?
Chickens	?	212	40	?	?
	1340	13504	3042	21237	21677
Livestock Water Use (gpd)					
Milk Cows (25)	126067	123608	116532	125826	133620
Other Cattle & Calves (12)	70775	66925	70950	76825	86200
Swine (5.0)	51312	52164	41952	41928	42708
Sheep & Lambs (2.0)	1195	1520	1090	1830	1275
Horses (12)	780	384	400	1472	1486
Turkeys (0.15)	1884	1368	1860	1860	?
Chickens (0.09)	?	32	6	0	?
	121	1215	234	1911	1951
Livestock Consumptive Use (gpd)**	94550	92706	87399	94370	100215

* 1969 and 1974 data for turkeys and 1964 data for chickens include only farms with sales of $2,500 and over.

** Consumptive use was assumed to be 75% of total use.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, & 1982).

TIOGA COUNTY, PA. LIVESTOCK

Parameter	1982	1978	1974	1969	1964
Livestock Numbers*	222098	298461	344807	559958	267717
Milk Cows	22274	20200	20651	19869	23833
Other Cattle & Calves	24681	19194	23018	21284	21488
Swine	2802	1360	1377	594	900
Sheep & Lambs	4150	3412	5186	7088	6101
Horses	720	966	837	960	?
Turkeys	94	101	?	24	?
Chickens	167377	253288	293738	510139	215395
Livestock Water Use (gpd)	906000	789000	853000	835000	896000
Milk Cows (25)	560000	510000	520000	500000	600000
Other Cattle & Calves (12)	300000	230000	280000	260000	260000
Swine (5.0)	14000	6800	6900	3000	4500
Sheep & Lambs (2.0)	8300	6800	10000	14000	12000
Horses (12)	8600	12000	10000	12000	?
Turkeys (0.15)	14	15	?	4	?
Chickens (0.09)	15000	23000	26000	46000	19000
Livestock Consumptive Use (gpd)**	680000	590000	640000	630000	670000

* 1969 and 1974 data for turkeys and 1964 data for chickens include only farms with sales of $2,500 and over.

** Consumptive use was assumed to be 75% of total use.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, & 1982).

UNION COUNTY, PA. LIVESTOCK

Parameter	1982	1978	1974	1969	1964
Livestock Numbers*	304382	155008	243846	233613	134092
Milk Cows	6636	6365	5944	5864	6646
Other Cattle & Calves	12251	11055	10582	9423	7733
Swine	14251	16594	8325	7264	5019
Sheep & Lambs	371	495	365	1053	609
Horses	457	367	345	319	?
Turkeys	125598	?	60046	150	?
Chickens	144818	120132	158239	209540	114085
Livestock Water Use (gpd)	422267	390961	345328	320812	295527
Milk Cows (25)	165900	159125	148600	146600	166150
Other Cattle & Calves (12)	147012	132660	126984	113076	92796
Swine (5.0)	71255	82970	41625	36320	25095
Sheep & Lambs (2.0)	742	990	730	2106	1218
Horses (12)	5484	4404	4140	3828	?
Turkeys (0.15)	18840	?	9007	23	?
Chickens (0.09)	13034	10812	14242	18859	10268
Livestock Consumptive Use (gpd)**	316700	293221	258996	240609	221645

* 1969 and 1974 data for turkeys and 1964 data for chickens include only farms with sales of $2,500 and over.

** Consumptive use was assumed to be 75% of total use.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, & 1982).

CAMBRIA COUNTY, PA. IRRIGATION

Parameter	1982	1978	1974	1969	1964
Approx. Area of County (Acres)*	442284	442889	442880	442880	444805
Proportion of Area in Farms	19.5	20.2	18.6	21.5	26.3
Land in Farms (Acres)	86209	89394	82374	95264	117075
Total Cropland	52924	57906	50483	54934	66104
Total Woodland	23604	22090	22646	29671	36804
Other Land	9681	8598	9245	10759	14177
Total Cropland (Acres)	52924	57906	50483	54934	66104
Harvested Cropland	40666	42604	39167	36702	47467
Land Used Only for Pasture	7210	9117	6938	8959	7215
Other Cropland	5054	6185	4378	9273	11386
No. Farms with Irrigated Land	12	10	8	7	2
Irrigated Land (Acres)	25	21	18	217	14
Harvested Cropland**	21	3	7	3	?
Pastureland & Other**	?	?	4	0	?
Irrigation Water Used (gpd)	48489	40731	34912	420885	27154
Irrigation Consumption (gpd)	41216	34621	29675	357752	23081

* Individual farms were considered either entirely in or out of county.
** 1969 and 1974 data include only farms with sales of $2,500 and over.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, and 1982).

CAMERON COUNTY, PA. IRRIGATION

Parameter	1982	1978	1974	1969	1964
Approx. Area of County (Acres)*	254976	256640	256640	256640	255365
Proportion of Area in Farms	?	1.6	1.0	1.3	2.4
Land in Farms (Acres)	?	3999	2506	3240	6283
Total Cropland	?	?	1186	1582	2108
Total Woodland	?	2242	1016	1419	3880
Other Land	?	?	304	239	294
Total Cropland (Acres)	?	?	1186	1582	2108
Harvested Cropland	?	?	614	585	667
Land Used Only for Pasture	?	?	491	823	1127
Other Cropland	?	?	81	174	314
No. Farms with Irrigated Land	?	?	0	0	0
Irrigated Land (Acres)	?	?	0	0	0
Harvested Cropland**	?	?	0	0	0
Pastureland & Other**	?	?	0	0	0
Irrigation Water Used (gpd)	?	?	0	0	0
Irrigation Consumption (gpd)	?	?	0	0	0

* Individual farms were considered either entirely in or out of county.
** 1969 and 1974 data include only farms with sales of $2,500 and over.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, and 1982).

CENTRE COUNTY, PA. IRRIGATION

Parameter	1982	1978	1974	1969	1964
Approx. Area of County (Acres)*	707891	713600	713600	713600	713605
Proportion of Area in Farms	22.5	23.0	20.4	20.5	28.1
Land in Farms (Acres)	159013	164046	145292	146160	201075
Total Cropland	102708	106449	93232	93207	116145
Total Woodland	40590	44769	36549	39370	64935
Other Land	15715	13028	15511	13583	19473
Total Cropland (Acres)	102708	106249	93232	93207	116145
Harvested Cropland	40590	44769	71933	64444	86054
Land Used Only for Pasture	13621	14771	16343	16094	16743
Other Cropland	4594	8621	4956	12659	13348
No. Farms with Irrigated Land	13	9	8	3	11
Irrigated Land (Acres)	47	161	107	18	365
Harvested Cropland**	47	160	97	18	?
Pastureland & Other**	--	--	0	0	?
Irrigation Water Used (gpd)	91159	312269	207533	34912	707939
Irrigation Consumption (gpd)	77485	265429	176403	29675	601748

* Individual farms were considered either entirely in or out of county.
** 1969 and 1974 data include only farms with sales of $2,500 and over.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, and 1982).

CLEARFIELD COUNTY, PA. IRRIGATION

Parameter	1982	1978	1974	1969	1964
Approx. Area of County (Acres)*	735289	738960	728960	728960	732165
Proportion of Area in Farms	9.1	9.2	9.2	9.4	14.5
Land in Farms (Acres)	67251	66718	66846	68854	106385
Total Cropland	40046	40175	38117	38952	56135
Total Woodland	18836	18381	19439	19618	35075
Other Land	8381	8162	8790	10294	15176
Total Cropland (Acres)	40046	40175	38117	38952	56135
Harvested Cropland	18800	18381	25322	23969	835676
Land Used Only for Pasture	6762	7519	8374	8417	6893
Other Cropland	3846	5578	4516	6066	13566
No. Farms with Irrigated Land	8	7	7	2	4
Irrigated Land (Acres)	17	56	36	3	26
Harvested Cropland**	17	56	35	3	?
Pastureland & Other**	--	--	0	0	?
Irrigation Water Used (gpd)	32973	108615	69824	5819	50429
Irrigation Consumption (gpd)	28027	92323	59350	4946	42865

* Individual farms were considered either entirely in or out of county.
** 1969 and 1974 data include only farms with sales of $2,500 and over.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, and 1982).

CLINTON COUNTY, PA. IRRIGATION

Parameter	1982	1978	1974	1969	1964
Approx. Area of County (Acres)*	570464	575360	575360	575360	577283
Proportion of Area in Farms	8.5	8.3	7.4	8.2	10.4
Land in Farms (Acres)	48498	47972	42708	47335	60140
Total Cropland	32832	31200	26844	31103	32561
Total Woodland	11866	12905	12305	13182	19320
Other Land	3800	3864	3559	3050	8265
Total Cropland (Acres)	32832	31200	26844	31103	32561
Harvested Cropland	27417	24359	20037	21354	24986
Land Used Only for Pasture	3964	4384	4904	4019	2835
Other Cropland	1451	2457	1823	5730	4740
No. Farms with Irrigated Land	3	5	1	4	8
Irrigated Land (Acres)	?	59	18	138	426
Harvested Cropland**	?	?	18	138	?
Pastureland & Other**	--	--	0	0	?
Irrigation Water Used (gpd)	?	114434	34912	267659	826253
Irrigation Consumption (gpd)	?	97269	29675	227510	702315

* Individual farms were considered either entirely in or out of county.
** 1969 and 1974 data include only farms with sales of $2,500 and over.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, and 1982).

ELK COUNTY, PA. IRRIGATION

Parameter	1982	1978	1974	1969	1964
Approx. Area of County (Acres)*	531142	516480	516352	516352	516485
Proportion of Area in Farms	3.5	3.9	2.9	3.0	6.0
Land in Farms (Acres)	18449	19886	14793	15376	31049
Total Cropland	9481	11956	8937	9425	13373
Total Woodland	6192	6707	4153	4817	12835
Other Land	2776	1223	1703	1134	4838
Total Cropland (Acres)	9481	11956	8937	9425	13373
Harvested Cropland	6192	6707	6746	5509	8654
Land Used Only for Pasture	1929	3352	1993	2803	2651
Other Cropland	824	543	198	1116	2068
No. Farms with Irrigated Land	2	2	1	1	0
Irrigated Land (Acres)	?	?	6	8	0
Harvested Cropland**	?	?	6	8	0
Pastureland & Other**	--	--	0	0	0
Irrigation Water Used (gpd)	?	?	11637	15517	0
Irrigation Consumption (gpd)	?	?	9892	13190	0

* Individual farms were considered either entirely in or out of county.
** 1969 and 1974 data include only farms with sales of $2,500 and over.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, and 1982).

LYCOMING COUNTY, PA. IRRIGATION

Parameter	1982	1978	1974	1969	1964
Approx. Area of County (Acres)*	791852	778240	777920	777920	776965
Proportion of Area in Farms	19.5	20.7	20.0	20.9	22.9
Land in Farms (Acres)	154673	161013	155936	162655	178145
Total Cropland	99117	100172	95864	96213	104674
Total Woodland	39085	46574	42497	48431	50539
Other Land	16471	14267	17575	18011	22890
Total Cropland (Acres)	99117	100172	95864	96213	104674
Harvested Cropland	80447	77698	71291	63757	76269
Land Used Only for Pasture	10610	12856	16204	14857	11656
Other Cropland	8030	9618	8369	17599	16749
No. Farms with Irrigated Land	16	17	14	10	12
Irrigated Land (Acres)	404	357	322	285	532
Harvested Cropland**	404	331	320	275	?
Pastureland & Other**	--	26	0	0	?
Irrigation Water Used (gpd)	783582	692423	624538	552775	1031846
Irrigation Consumption (gpd)	666045	588560	530857	469859	877069

* Individual farms were considered either entirely in or out of county.
** 1969 and 1974 data include only farms with sales of $2,500 and over.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, and 1982).

MONTOUR COUNTY, PA. IRRIGATION

Parameter	1982	1978	1974	1969	1964
Approx. Area of County (Acres)*	83852	83200	82944	82944	83200
Proportion of Area in Farms	58.2	66.2	56.8	60.7	68.5
Land in Farms (Acres)	48815	55125	47092	50368	57019
Total Cropland	38897	41237	35593	36915	39778
Total Woodland	6983	9888	7013	7875	11161
Other Land	2935	4000	4486	5578	6079
Total Cropland (Acres)	38897	41233	35593	36915	39778
Harvested Cropland	31638	32563	28195	23181	29520
Land Used Only for Pasture	2326	3472	3193	3352	2524
Other Cropland	4933	5202	4205	10382	7734
No. Farms with Irrigated Land	1	3	5	3	2
Irrigated Land (Acres)	?	6	17	68	8
Harvested Cropland**	?	6	17	68	?
Pastureland & Other**	--	--	0	0	?
Irrigation Water Used (gpd)	?	11637	32973	131890	15517
Irrigation Consumption (gpd)	?	9892	28027	112107	13190

* Individual farms were considered either entirely in or out of county.
** 1969 and 1974 data include only farms with sales of $2,500 and over.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, and 1982).

NORTHUMBERLAND COUNTY, PA. IRRIGATION

Parameter	1982	1978	1974	1969	1964
Approx. Area of County (Acres)*	294848	289920	290176	290176	290565
Proportion of Area in Farms	41.5	44.2	42.4	44.8	49.4
Land in Farms (Acres)	122420	128064	123114	130012	143565
Total Cropland	94367	93600	87036	92811	99218
Total Woodland	19404	25263	23466	24636	26272
Other Land	8649	9201	12612	12565	18065
Total Cropland (Acres)	94367	93600	87036	92811	99218
Harvested Cropland	81373	78586	68040	60555	73903
Land Used Only for Pasture	6682	7635	9777	12643	6772
Other Cropland	6312	7374	9219	19613	18543
No. Farms with Irrigated Land	27	14	16	13	12
Irrigated Land (Acres)	887	210	329	322	348
Harvested Cropland**	?	198	143	205	?
Pastureland & Other**	?	12	80	115	?
Irrigation Water Used (gpd)	1720390	407308	444159	624538	674967
Irrigation Consumption (gpd)	1462331	346212	377535	530857	573722

* Individual farms were considered either entirely in or out of county.
** 1969 and 1974 data include only farms with sales of $2,500 and over.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, and 1982).

POTTER COUNTY, PA. IRRIGATION

Parameter	1982	1978	1974	1969	1964
Approx. Area of County (Acres)*	692064	698880	698880	698880	697605
Proportion of Area in Farms	15.5	15.8	14.8	17.5	20.8
Land in Farms (Acres)	107157	110580	103323	122063	145295
Total Cropland	53174	52564	48097	53994	53357
Total Woodland	38420	42440	39161	49127	58469
Other Land	15563	15576	16065	18942	33467
Total Cropland (Acres)	53174	52564	48097	53994	53357
Harvested Cropland	36714	33844	30265	31221	38309
Land Used Only for Pasture	11246	13728	12339	14955	7172
Other Cropland	5209	4992	5493	7818	7876
No. Farms with Irrigated Land	3	1	1	0	0
Irrigated Land (Acres)	5	?	1	0	0
Harvested Cropland**	5	?	?	0	0
Pastureland & Other**	--	--	0	0	0
Irrigation Water Used (gpd)	9698	?	1940	0	0
Irrigation Consumption (gpd)	8243	?	1649	0	0

* Individual farms were considered either entirely in or out of county.
** 1969 and 1974 data include only farms with sales of $2,500 and over.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, and 1982).

SULLIVAN COUNTY, PA. IRRIGATION

Parameter	1982	1978	1974	1969	1964
Approx. Area of County (Acres)*	288614	305920	305920	305920	305925
Proportion of Area in Farms	12.4	12.4	12.0	14.4	18.1
Land in Farms (Acres)	35654	38026	36842	44010	55583
Total Cropland	18318	18774	16527	19408	19648
Total Woodland	66350	75528	12910	15673	20442
Other Land	5566	7792	7405	8929	15495
Total Cropland (Acres)	18318	18774	16527	19408	19648
Harvested Cropland	13614	13554	11731	12453	15153
Land Used Only for Pasture	3203	4307	3884	5148	2413
Other Cropland	1501	913	912	1807	2082
No. Farms with Irrigated Land	0	1	0	0	1
Irrigated Land (Acres)	0	?	0	0	5
Harvested Cropland**	0	?	0	0	?
Pastureland & Other**	0	?	0	0	?
Irrigation Water Used (gpd)	0	?	0	0	9698
Irrigation Consumption (gpd)	0	?	0	0	8243

* Individual farms were considered either entirely in or out of county.
** 1969 and 1974 data include only farms with sales of $2,500 and over.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, and 1982).

TIOGA COUNTY, PA. IRRIGATION

Parameter	1982	1978	1974	1969	1964
Approx. Area of County (Acres)*	723974	733440	733440	733440	736005
Proportion of Area in Farms	33.1	34.1	31.1	35.1	42.7
Land in Farms (Acres)	239846	250095	228189	257320	314525
Total Cropland	143147	146237	124120	128085	134289
Total Woodland	790	798	56503	70222	86140
Other Land	95909	103060	47566	59013	94081
Total Cropland (Acres)	143147	146237	124120	128085	134289
Harvested Cropland	102124	99408	82041	76588	103535
Land Used Only for Pasture	33969	38860	34663	37062	15578
Other Cropland	7054	7969	7416	14435	15176
No. Farms with Irrigated Land	7	5	1	2	2
Irrigated Land (Acres)	96	35	12	5	16
Harvested Cropland**	?	35	12	5	?
Pastureland & Other**	?	0	0	0	?
Irrigation Water Used (gpd)	186198	67885	23275	9698	31033
Irrigation Consumption (gpd)	158268	57702	19784	8243	26378

* Individual farms were considered either entirely in or out of county.
** 1969 and 1974 data include only farms with sales of $2,500 and over.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, and 1982).

UNION COUNTY, PA. IRRIGATION

Parameter	1982	1978	1974	1969	1964
Approx. Area of County (Acres)*	202835	203520	203520	203520	203525
Proportion of Area in Farms	36	36.9	37.2	34.4	39.7
Land in Farms (Acres)	72935	75142	75792	69959	80911
Total Cropland	56207	56696	54652	56261	59265
Total Woodland	7422	9992	8893	7674	9666
Other Land	9306	8454	12247	6024	11972
Total Cropland (Acres)	56207	56992	54652	56261	59265
Harvested Cropland	49232	47688	44946	40649	46681
Land Used Only for Pasture	4832	5363	6641	9090	4582
Other Cropland	2113	3645	3065	6522	8002
No. Farms with Irrigated Land	10	3	3	4	13
Irrigated Land (Acres)	82	3	14	63	196
Harvested Cropland**	65	3	13	63	?
Pastureland & Other**	17	--	0	0	?
Irrigation Water Used (gpd)	159044	5819	27154	122192	380154
Irrigation Consumption (gpd)	135187	4946	23081	103863	323131

* Individual farms were considered either entirely in or out of county.
** 1969 and 1974 data include only farms with sales of $2,500 and over.

Source: Derived from U.S. Department of Commerce (1969, 1974, 1978, and 1982).

APPENDIX D

SOCIAL-POLITICAL CONSIDERATIONS

SOCIAL-POLITICAL CONSIDERATIONS

Any management action must meet certain criteria if it is to be deemed acceptable. Chief among these are technical feasibility and economic feasibility. The first asks, "Is it physically possible to do what is being proposed?" The other asks if the benefit of the action to the nation or the region--the "social benefit"--exceeds the "social cost?" Basically, these are technical questions, readily answered by technicians. However, they address only a part of the feasibility considerations. . The perceptions of local government officials, "key influentials", and the affected citizenry are vitally important in determining whether the proposed action is deemed acceptable, i.e., politically feasible. Without such local support, the best technical analyses can be for nought.

There is evidence to indicate that when presented with adequate information on alternative solutions to problems, citizens can evaluate the trade-off between risk and cost, and reach a consensus.

For example, consider the situation in which a community is confronted with the possibility of severe water use restrictions during periods of moderate to severe drought unless their water supply is expanded. Suppose also that the water supply can be expanded by three different amounts, the largest (and most costly) of which will eliminate any need for water use

restrictions during a repeat of the drought of record. During the course of public information and education efforts, the community gains an understanding of the probabilistic nature of drought occurrence as well as the degree of water use restrictions associated with various drought intensities for each of the water supply expansion proposals. With this information in hand the leaders of the community can make a reasoned choice between the amount of risk they are willing to tolerate and the costs they are willing to bear. An actual decision of this sort was made recently in the mid-Atlantic region. The parties, while not opting for the least costly (and most risky) option did trade-off some increased risk for some cost savings.

The situations become more complex when the beneficiaries of a management action are widely separated geographically from the locale in which the action is taken. A good example is the reformulation of the Cowanesque Lake project. Local communities, county and state government, and citizen organizations were concerned about a number of issues relating to the proposed new operating regimen at the project. And their support was essential if the reformulation proposal was to go forward. The SRBC dealt with the situation in the following manner.

A detailed study of all conceivable impacts was planned and carried out. At the same time an advisory committee made up of representatives of the various interest groups was formed. The

committee was involved in the entire process from planning the study to reviewing the final report. Because of their involvement, the committee members viewed the study findings as objective and accurate. When the study concluded that the proposed reformulation would have little or no negative impacts, all of the local interests supported the proposal.

The necessity of establishing multi-faceted feasibility if a water management action is to go forward is well recognized. Any action suggested in this framework plan should be subjected to the sorts of social/political evaluation described here as well as the more narrowly focused technical and economic evaluations.

1138

SUSQUEHANNA RIVER BASIN COMMISSION

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